DATA SHEET

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ORISE TECH

OTM8009A

1440-channel 8-bit Source Driver and 864 Gate Driver with System-on-chip for Color Amorphous TFT-LCDs

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Preliminary

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1440-CHANNEL Source DRIVER and 864 Gate DriverWITH SYSTEM-ON-CHIP (SOC) FOR Color Amophomous TFT LCD

1. GENERAL DESCRIPTION

The OTM8009A, a 16,777,216-color System-on-Chip (SoC) driver LSI designed for small and medium sizes of TFT LCD display, is capable of supporting up to 480xRGBx864 (WVGA) in resolution which can be achieved by the integrated RAM for graphic data. The 480-channel source driver has true 8-bit resolution, which generates 256 Gamma-corrected values by an internal D/A converter.

The OTM8009A is able to operate with low IO interface power supply and incorporate with several charge pumps to generate various voltage levels that form an on-chip power management system for gate driver and source driver.

The built-in timing controller in OTM8009A can support several interfaces for the diverse request of medium or small size portable display. OTM8009A provides several system interfaces, which include MIPI/MDDI/CPU/RGB/SPI/I2C. Not only can the system interfaces be used to configure system, they can also access RAM at high speed for still picture display. The OTM8009A also supports a function to display eight colors and a standby mode for power control consideration. For further power control, the dynamic backlight control function basing on displaying image content is also supported.

2. FEATURES

- One-chip solution for color amorphous TFT-LCD.
- Support various resolution
  - 480XRGBX864(WVGA)
  - 480XRGBX854(WVGA)
  - 480XRGBX800(WVGA).
  - 480XRGBX720
  - 480XRGBx640(VGA)
  - 480XRGBx480
  - 480XRGBx360(HVGA)
- Outputs 256γ-corrected values using an internal true 8-bit resolution D/A converter to achieve 16,777,216 colors
- Built-in digital separate RGB gamma
- Built-in single full video RAM with support up to WVGA
- Built-in DC-VCOM.
- System interfaces
  - MIPI DSI (1 data lane)：transmission bit rate up to 725 Mb/s per data channel.
  - MIPI DSI (2 data lane)：transmission bit rate up to 550 Mb/s per data channel.
    *MIPI DSI (DSI v1.01.00, D-PHY v1.00.00 and DCS v1.01).
  - MDDI (2 lane)；. transmission bit rate up to 550 Mb/s per data channel.
  - CPU (8/16/24) interface
  - RGB (16/18/24) interface
  - SPI/I2C interface
- Diverse RAM accessing for functional display
  - Window address function to display at any area on the screen via a moving picture display interface
  - Window address function to limit the data rewriting area and reduce data transfer
  - Moving and still picture can display at the same time.
  - Partial / Window screen display
- Power supply
  - Logic power supply voltage (VDDIO): 1.1 ~ 1.3 V；1.65 ~ 3.3V
  - Analog power supply voltage (VPNL): 2.3 ~ 4.8V
- On-chip power management system
  - Power saving mode (standby / 8-color mode, etc)
  - Low power consumption structure for source driver.
  - Dynamic backlight control function.
- Built-in Charge Pump circuits
  - Source output voltage level GVDD-GVSS: 3.1125 ~ 6.3V
    NGVDD-NGVSS: -3.1125 ~ --6.3V
- Built-in internal oscillator and hardware reset.
- Built–in OTP (4 Times) to store VCOM calibration and ID1~ID3.

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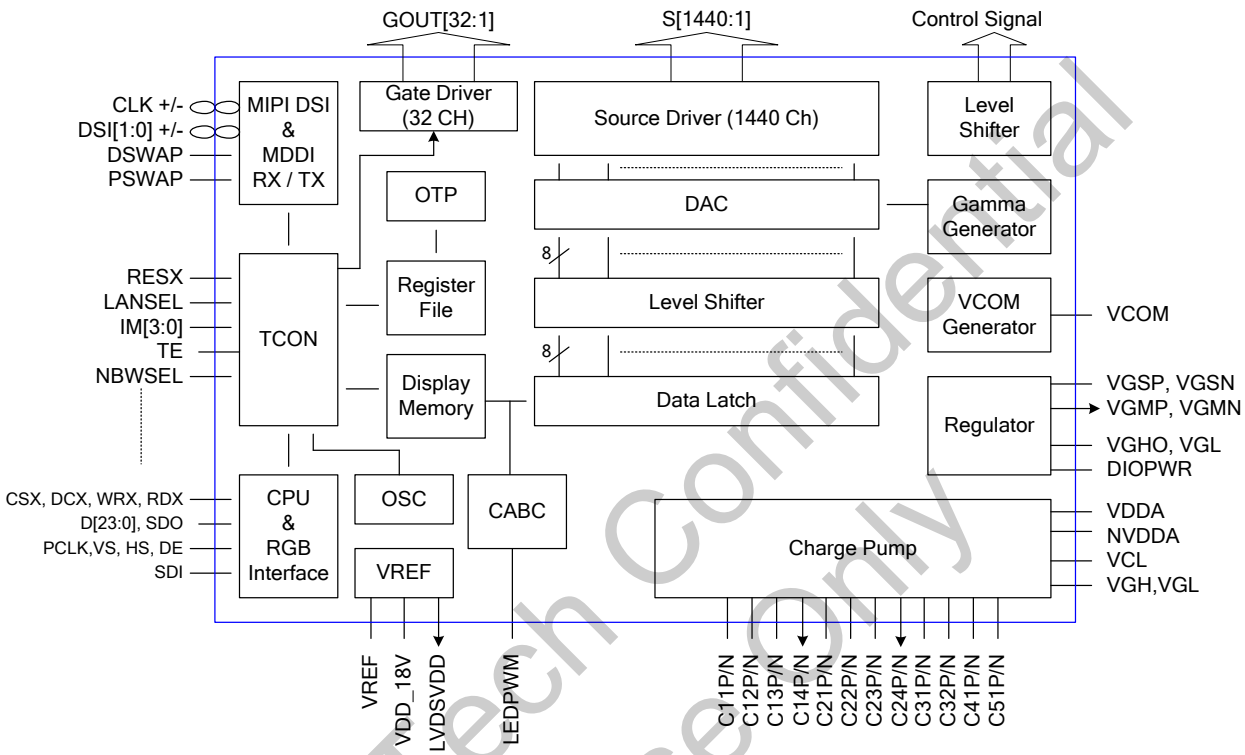
3. BLOCK DIAGRAM

3.1. Block Function



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3.1.1. System interface

The OTM8009A supports the high-speed system interface, MIPI (Mobile Industry Processor Interface), and MDDI, also support I80 and RGB interface.

The OTM8009A has a index register (IR) for MIPI (8-bit) and two data registers, a write-data register (WDR) and a read-data register (RDR). The IR register is used to store index information from control registers. The WDR register is used to temporarily store data to be written for register control and internal GRAM. The RDR register is used to temporarily store data read from the GRAM. When graphic data is written to the internal GRAM from MCU/graphic engine, the data is first written to the WDR and then automatically written to the internal GRAM in internal operation. When graphic data read operation is executed, graphic data is first read to the RDR from the internal GRAM by internal generated read operation pulse. Therefore, valid data can be read out right after the OTM8009A executes the 1nd read operation.

3.1.2. Address Counter (AC)

OTM8009A features an Address Counter (AC) giving an address to the internal GRAM. The address in the AC is automatically updated plus or minus 1. The window address function enables writing data only in the rectangular area arbitrarily set by users on the GRAM.

3.1.3. Graphics RAM (GRAM)

OTM8009A features a 1244160-byte (480 x 864 x 24 / 8) Graphic RAM (GRAM).

3.1.4. Grayscale voltage generating circuit

OTM8009A has true 8-bit resolution D/A converter, which generates 256 Gamma-corrected values and cooperates with OP-AMP structure to enhance display quality. The grayscale voltage can be adjusted by grayscale data set in the γ-correction register and RGB can be adjusted separately.

3.1.5. Timing controller

OTM8009A has a timing controller, which can generate a timing signal for internal circuit operation such as gate output timing, RAM accessing timing, etc.

3.1.6. Oscillator (OSC)

The OTM8009A also features an internal oscillator to generate RC oscillation with an internal resistor. In standby mode, RC oscillation is halted to reduce power consumption.

3.1.7. Source driver circuit

OTM8009A consists of a 1440-output source driver circuit (S1 ~ S1440). Data in the GRAM are latched when a single line data has been accumulated. And, then the latched data controls the source driver and generates a drive waveform.

3.1.8. Gate driver circuit

OTM8009A consists of output gate driver control circuit. The gate driver circuit outputs gate driver signals at either VGH or VGL level.

3.1.9. LCD driving power supply circuit

The LCD driving power supply circuit generates the voltage levels VDDA, VGH, VGL and VCOM for driving an LCD. All this voltages can be adjusted by register setting.

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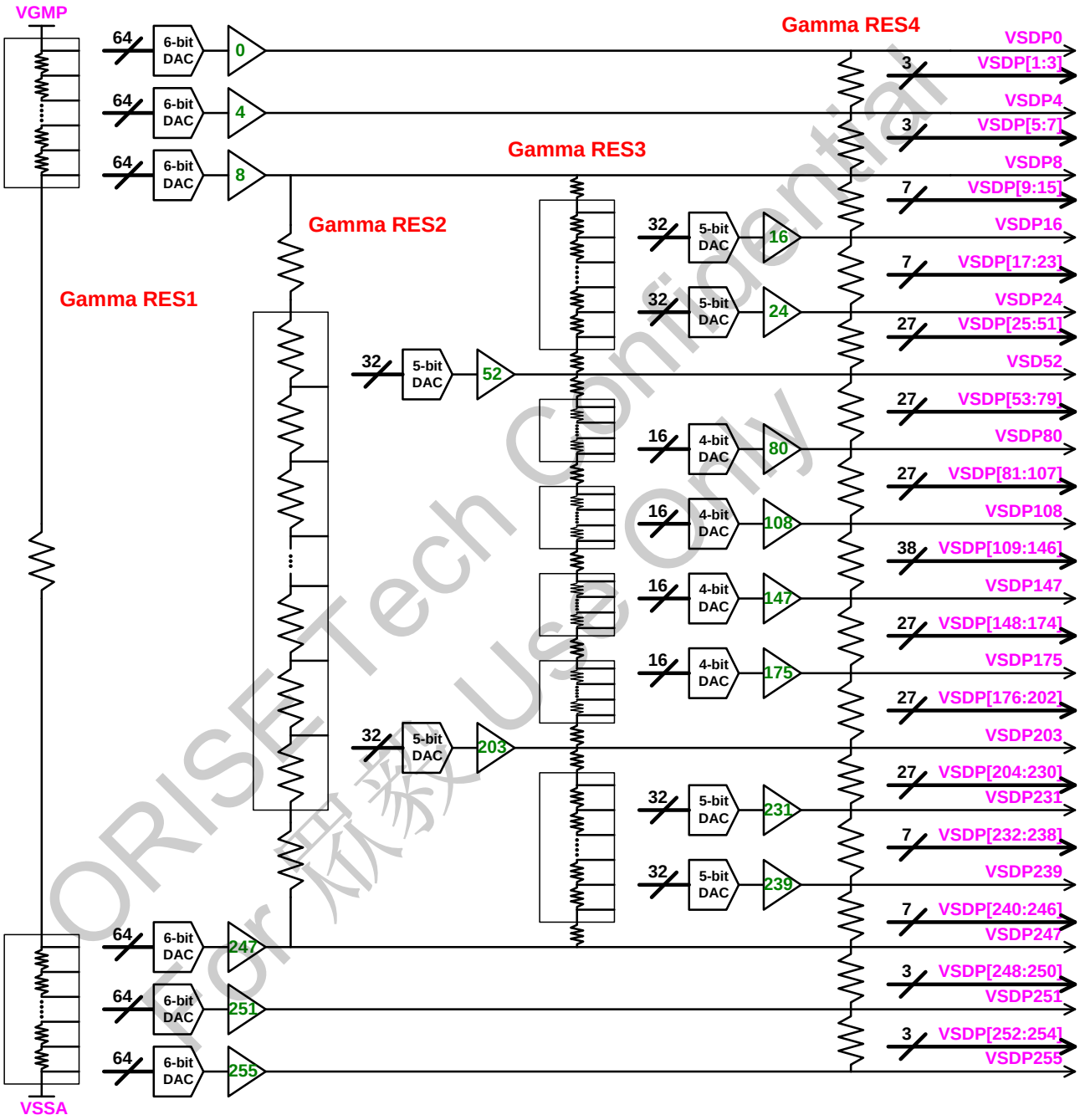
3.2. Gamma Correction Circuit

3.2.1. Positive gamma correction circuit



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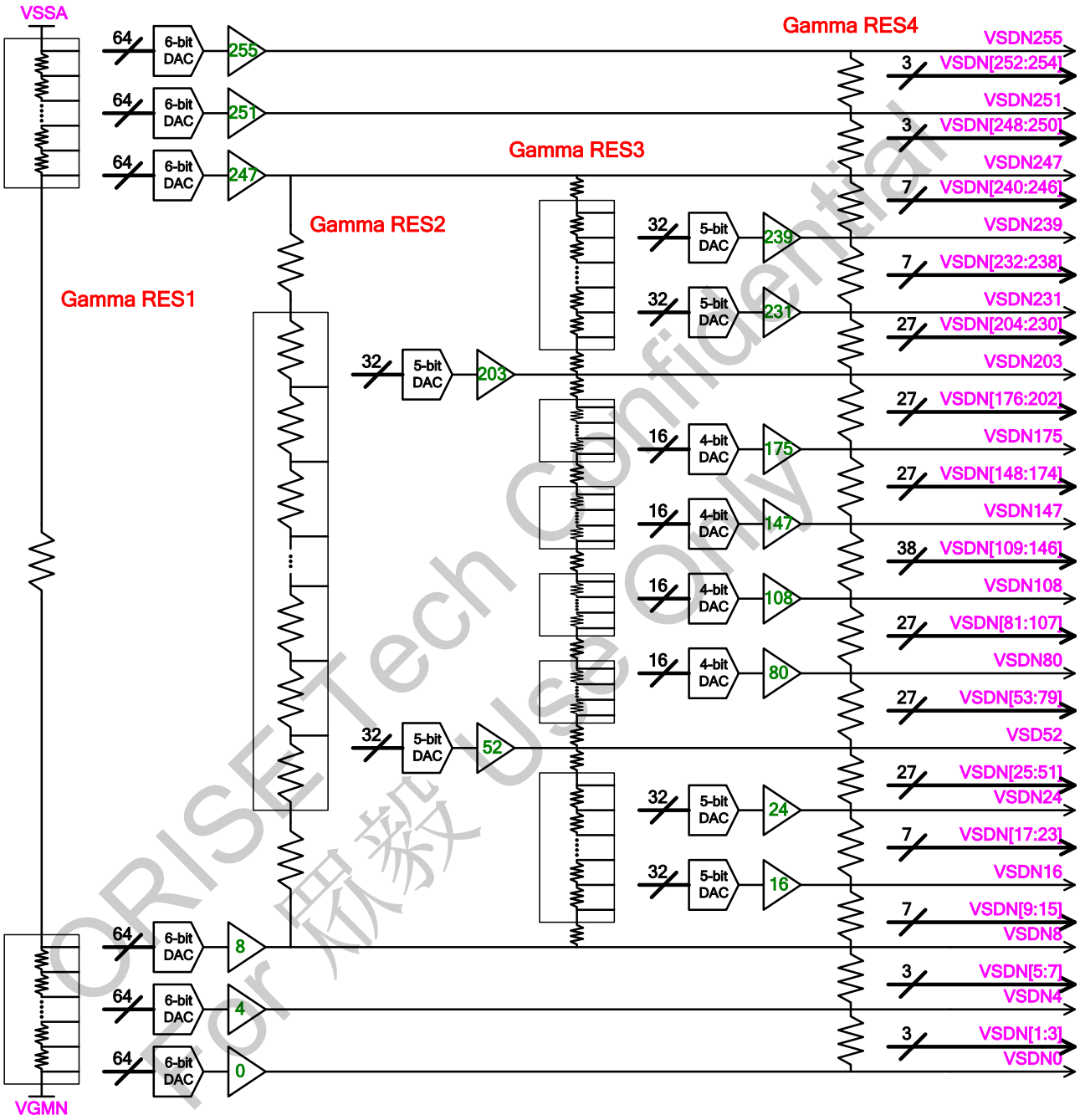
3.2.2. Negative gamma correction circuit



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4. SIGNAL DESCRIPTIONS

4.1. Pin Definition

<table>
<tr><th>Signal</th><th>I/O</th><th>PAD Type (Voltage Level)</th><th>Function</th></tr>
<tr><td colspan="4">Global Control Signal</td></tr>
<tr><td>IM[2:0]</td><td>I</td><td>Digital (VDDIO)</td><td>Interface mode select pins.
Notes:
(1) Frame buffer writing by MDDI and register reading (or writing) by SPI(or I2C) could work at the same time.
(2) When MDDI is in stand-by mode, the SPI(or I2C) can also read / write registers and frame buffer.
(3) MDDI could read / write registers and frame buffer only when SPI (or I2C) is inactive.
<table>
<tr><th colspan="3">External Pad Set</th><th rowspan="2">Interface format</th></tr>
<tr><th>IM2</th><th>IM1</th><th>IM0</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>80-series 8-bit MPU interface</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>80-series 16-bit MPU interface</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>80-series 24-bit MPU interface</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>RGB + SPI</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>RGB + I2C</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>MIPI-DSI</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>MDDI + SPI</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>MDDI + I2C</td></tr>
</table></td></tr>
<tr><td>IM[3]</td><td>I</td><td>Digital (VDDIO)</td><td>Input pin to select the SCL rising/falling edge trigger for SPI I/F only.
- IM3=”0”, SCL rising edge trigger
- IM3=”1”, SCL falling edge trigger
If not used, please connect to VSSI.</td></tr>
<tr><td>RESX</td><td>I</td><td>Digital</td><td>Global Reset Signal. Active Low. If not used please let it floating.</td></tr>
<tr><td>TE_L</td><td>O</td><td>Digital</td><td>Tearing effect output pin to synchronies MCU to frame writing, activated by S/W command. When this pin is not activated (TE function OFF), this pin is VSS level.</td></tr>
<tr><td>TE_R(TE)</td><td>O</td><td>Digital</td><td>Tearing effect output pin to synchronies MCU to frame writing, activated by S/W command. When this pin is not activated (TE function OFF), this pin is VSS level.</td></tr>
<tr><td>LEDPWM</td><td>O</td><td>Digital</td><td>LCD backlight control PWM output pin</td></tr>
<tr><td>LEDON</td><td>O</td><td>Digital</td><td>Enable pulse for the backlight driver</td></tr>
<tr><td>VSEL</td><td>I</td><td>Digital</td><td>DIOPWR voltage select
“Low” = 1.2V IO mode
“High” = 1.8V IO mode</td></tr>
<tr><td>I2C_SA[1:0]</td><td>I</td><td>Digital</td><td>Selection of I2C slave address Connect to VSS if not used.
2’b00 : Slave Address=1001100
2’b01 : Slave Address=1001101
2’b10 : Slave Address=1001110
2’b11 : Slave Address=1001111</td></tr>
<tr><td>NBWSEL</td><td>I</td><td>Digital</td><td>Selection for NB(Normally Black)/NW(Normally White) panel. 0 : NW, 1 : NB</td></tr>
<tr><td>DSTB_SEL</td><td>I</td><td>Digital</td><td>Control pin for DIOPWR regulator.
0 : not used , 1 : used for TE/LEDON/LEDPWM.</td></tr>
</table>

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<table>
<tr><th>Signal</th><th>I/O</th><th>PAD Type (Voltage Level)</th><th>Function</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th rowspan="2">DSTB_SEL</th><th rowspan="2">VDDIO</th><th rowspan="2">VSEL</th><th rowspan="2">DIOPWR</th><th colspan="2">Output voltage level</th></tr>
<tr><th>TE</th><th>LEDON, LEDPWM</th></tr>
<tr><td rowspan="2">0</td><td rowspan="2">1.65~3.3v
or
1.1~1.3v</td><td>Low</td><td>1.2v</td><td>VOH=VDDIO
VOL=VSS</td><td>VOH=VDDIO or VDD
VOL=VSS</td></tr>
<tr><td>High</td><td>1.8v</td><td>VOH=VDDIO
VOL=VSS</td><td>VOH=VDDIO or VDD
VOL=VSS</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">1.65~3.3v</td><td>Low</td><td>1.2v</td><td>VOH=DIOPWR
VOL=VSS</td><td>VOH=DIOPWR
VOL=VSS</td></tr>
<tr><td>High</td><td>1.8v</td><td>VOH=VDDIO or DIOPWR
VOL=VSS</td><td>VOH=VDDIO or VDD
VOL=VSS</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">1.1~1.3v</td><td>Low</td><td>1.2v</td><td>VOH=DIOPWR
VOL=VSS</td><td>VOH=DIOPWR
VOL=VSS</td></tr>
<tr><td>High</td><td>1.8v</td><td>VOH=DIOPWR
VOL=VSS</td><td>VOH=DIOPWR
VOL=VSS</td></tr>
</table>
</td></tr>
<tr><td>GPO[3:0]</td><td>I/O</td><td>Digital</td><td>GPO2 is used as Hsync output. The other pins can be open.</td></tr>
<tr><td colspan="4">MIPI-DSI/ MDDI Interface Signals</td></tr>
<tr><td>CLK-STB+</td><td>I</td><td>MIPI/MDDI
(LVDSVDD)</td><td>MIPI-DSI clock Lane positive-end input pin/
MDDI strobe Lane positive-end input pin</td></tr>
<tr><td>CLK-STB-</td><td>I</td><td>MIPI/MDDI
(LVDSVDD)</td><td>MIPI-DSI clock Lane negative-end input pin/
MDDI strobe Lane negative-end input pin</td></tr>
<tr><td>DSI-D0+</td><td>I/O</td><td>MIPI/MDDI
(LVDSVDD)</td><td>MIPI-DSI data Lane 0 positive-end input/output pin/
MDDI data Lane 0 positive-end input/output pin
* Please connected to LVDSVSS if not used</td></tr>
<tr><td>DSI-D0-</td><td>I/O</td><td>MIPI/MDDI
(LVDSVDD)</td><td>MIPI-DSI data Lane 0 negtive-end input/output pin/
MDDI data Lane 0 negtive-end input/output pin
* Please connected to LVDSVSS if not used</td></tr>
<tr><td>DSI-D1+</td><td>I</td><td>MIPI/MDDI
(LVDSVDD)</td><td>MIPI-DSI data Lane 1 positive-end input pin/
MDDI data Lane 1 positive-end input pin
* Please connected to LVDSVSS if not used</td></tr>
<tr><td>DSI-D1-</td><td>I</td><td>MIPI/MDDI
(LVDSVDD)</td><td>MIPI-DSI data Lane 1 negtive-end input pin/
MDDI data Lane 1 negative-end input pin
* Please connected to LVDSVSS if not used</td></tr>
<tr><td>LANSEL</td><td>I</td><td>Digital</td><td>MIPI-DSI Lane no. Select
Lane_SEL = “0”, MIPI-DSI is 1 Lane mode
Lane_SEL = “1”, MIPI-DSI is 2 Lane mode</td></tr>
<tr><td>ERR</td><td>O</td><td>Digital</td><td>ECC and CRC error flag for MIPI-DSI. It outputs high if ECC/CRC error occurs. It outputs Low always if not activated. Let it open if not used.</td></tr>
<tr><td>PSWAP</td><td>I</td><td>Digital</td><td>Polarity swapping. * Please connected to ground if not used</td></tr>
<tr><td>DSWAP</td><td>I</td><td>Digital</td><td>Data Lanes swapping
The attached is Polarity/Data-bus swap table for 1/2 lanes
* Please connected to ground if not used
<table>
<tr><th colspan="3" rowspan="2">MIPI/MDDI 2CH</th><th colspan="2">DSWAP</th><th colspan="2">DSWAP</th></tr>
<tr><th>0</th><th>1</th><th>0</th><th>1</th></tr>
<tr><td colspan="2"></td><td>PSWAP</td><td colspan="2">0</td><td colspan="2">1</td></tr>
<tr><td rowspan="6">2-lane</td><td rowspan="2">CH0</td><td>DP</td><td>D0P</td><td>D1P</td><td>D0N</td><td>D1N</td></tr>
<tr><td>DN</td><td>D0N</td><td>D1N</td><td>D0P</td><td>D1P</td></tr>
<tr><td rowspan="2">CLK</td><td>CLKP</td><td>CLKP</td><td>CLKP</td><td>CLKN</td><td>CLKN</td></tr>
<tr><td>CLKN</td><td>CLKN</td><td>CLKN</td><td>CLKP</td><td>CLKP</td></tr>
<tr><td rowspan="2">CH1</td><td>DP</td><td>D1P</td><td>D0P</td><td>D1N</td><td>D0N</td></tr>
<tr><td>DN</td><td>D1N</td><td>D0N</td><td>D1P</td><td>D0P</td></tr>
</table>
</td></tr>
</table>

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<table>
<tr><th>Signal</th><th>I/O</th><th>PAD Type (Voltage Level)</th><th>Function</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th colspan="3" rowspan="2">MIPI/MDDI 1CH</th><th colspan="2">DSWAP</th><th colspan="2">DSWAP</th></tr>
<tr><th>0</th><th>1</th><th>0</th><th>1</th></tr>
<tr><td></td><td colspan="2">PSWAP</td><td colspan="2">0</td><td colspan="2">1</td></tr>
<tr><td rowspan="6">1-lane</td><td rowspan="2">CH0</td><td>DP</td><td>D0P</td><td></td><td>D0N</td><td></td></tr>
<tr><td>DN</td><td>D0N</td><td></td><td>D0P</td><td></td></tr>
<tr><td rowspan="2">CLK</td><td>CLKP</td><td>CLKP</td><td>CLKP</td><td>CLKN</td><td>CLKN</td></tr>
<tr><td>CLKN</td><td>CLKN</td><td>CLKN</td><td>CLKP</td><td>CLKP</td></tr>
<tr><td rowspan="2">CH1</td><td>DP</td><td></td><td>D0P</td><td></td><td>D0N</td></tr>
<tr><td>DN</td><td></td><td>D0N</td><td></td><td>D0P</td></tr>
</table>
</td></tr>
<tr><td colspan="4">MPU/ RGB/ SPI/ I2C Interface</td></tr>
<tr><td>CSX</td><td>I</td><td>Digital (VDDIO)</td><td>Chip select signal.
”0” : the OTM8009A is accessible
”1” : the OTM8009A is not accessible
This pin can be permanently fixed “0” in MCU interface mode only.</td></tr>
<tr><td>DCX</td><td>I</td><td>Digital (VDDIO)</td><td>Display data / Command selection pin in parallel interface
“0” : Command data
“1” : Display data
Must connect to the VSS or VDDIO level when not used.</td></tr>
<tr><td>WRX/ R_WX/ SCL/ I2C_SCL</td><td>I</td><td>Digital (VDDIO)</td><td>In MPU interface mode, a write strobe signal can be input via this pin and initializes a write operation when the signal is low.
Must connect to the VSS or VDDIO level when not used.
[Serial-IF] SCL: Serial interface Clock Input
[I2C-IF]I2C_SCL:Serial Clock input</td></tr>
<tr><td>RDX/E</td><td>I</td><td>Digital (VDDIO)</td><td>In MPU interface mode, a read strobe signal can be input via this pin and initializes a read operation when the signal is low.
Must connect to the VSS or VDDIO level when not in use.</td></tr>
<tr><td>D[23:0]</td><td>I/O</td><td>Digital (VDDIO)</td><td>MPU/RGB I/F Data Input/Output. If not in use, it can be open or connect them to ground</td></tr>
<tr><td>DE</td><td>I</td><td>Digital (VDDIO)</td><td>RGB interface Data Enable Input. If not in use, it can be open or connect it to ground</td></tr>
<tr><td>PCLK</td><td>I</td><td>Digital (VDDIO)</td><td>RGB interface Picel clock Input. If not in use, it can be open or connect it to ground</td></tr>
<tr><td>HS</td><td>I</td><td>Digital (VDDIO)</td><td>RGB interface Hsync. Input. If not in use, it can be open or connect it to ground</td></tr>
<tr><td>VS</td><td>I</td><td>Digital (VDDIO)</td><td>RGB interface Vsync. Input. If not in use, it can be open or connect it to ground</td></tr>
<tr><td>SDI/ I2C_SDA</td><td>I</td><td>Digital (VDDIO)</td><td>[Serial-IF]SDI :Serial interface DATA Input
[I2C-IF]I2C_SDA:Serial data input. If not in use, it can be open or connect it to ground</td></tr>
<tr><td>SDO</td><td>O</td><td>Digital (VDDIO)</td><td>Serial interface DATA output</td></tr>
<tr><td colspan="4">Source/Panel control and VCOM Signals</td></tr>
<tr><td>S[1440:1]</td><td>O</td><td>Analog</td><td>Output source driver signals. The D/A converted 256-gray-scale analog voltage is output.</td></tr>
<tr><td>GOUT(GDOUT) [32:1]</td><td>O</td><td>Analog</td><td>Gate control signals for panel</td></tr>
</table>

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Signal	I/O	PAD Type (Voltage Level)	Function
SDUM0 ~SDUM3	O	Analog	Source dummy output
VCOM	O	Analog	VCOM signal output
Test/ Debugging/ Dummy Pins			
PADA[4:1]	I/O		For bonding resistance measurement. There are two groups of pins, they are(1). (PADA1, PADA2). (2). (PADA3, PADA5, PADA6) and (PADA4, PADA7). The pins in each groups are short together.
PADB[4:1]	I/O		For bonding resistance measurement. There are two groups of pins, they are (1). (PADB1, PADB2) (2). (PADB3, PADB5, PADB6), and (PADB4, PADB7). The pins in each groups are short together.
TEST[7:0]	I/O		Test pin. please let them float.
OSC_TEST	I/O		Test pin. please let them float.
VREFCP		Analog	Test pin
LVGL[2:1]		Analog	Test pin
VGSW[3:0]	I	Digital	Test pin
CSP	O	Analog	Dummy pins Hi-Z state
CSN	O	Analog	Dummy pins Hi-Z state
EXTP	O	Analog	Dummy pins Hi-Z state
EXTN	O	Analog	Dummy pins Hi-Z state
CONTACT[2:1]A	O	Analog	Dummy pins Hi-Z state
CONTACT[2:1]B	O	Analog	Dummy pins Hi-Z state
VRGH_DMY	O	Analog	Dummy pins Hi-Z state
VGL_REG1	O	Analog	Dummy pins Hi-Z state
EXB1T	I	Digital	Dummy Pin
Charge Pump Capacitor			
C11P/N, C12P/N C13P/N, C14P/N, C21P/N, C22P/N, C23P/N, C24P/N, C31P/N, C32P/N, C41P/N, C51P/N	C	Step-up capacitor	Connect boost capacitors for the internal DC/DC converter circuit to these pins. Leave the pins open when DC/DC converter circuits are not used.
Power Supply and Regulator pins			
VCC	I	Power Supply	Power supply to the internal logic power regulator circuit (VCC=2.3 to 4.8V)
VDD(VPNL)	I	Power Supply	Power Supply input for analog circuit. (VDDA,VDDR,VDD_DET,VDD_R,VDDB)
VDDIO	I	Power Supply	External Power Supply for Digital Circuits and IO pads. VDDIO=1.65 to 3.3V VDDIOL=1.1V to 1.3V (VDDI_OPT1,VDDI_OPT2,VDDI)
MTP_PWR	I	Power Supply	- Input power for NV memory programming - Input power range : 7.25 ~ 7.75V (Typical=7.5V) - When not under programming, MTP_PWR pin can be float or tied to ground.
VDDAM	I	Power Supply	Power Supply for MIPI/MDDI regulator circuits.(VDDAM=2.3 to 4.8V)
VSSA	I	Ground	Analog Ground (AVSS)
VSS	I	Ground	Digital Ground (VSSIDUM[3:0],VSSR,DVSS,VSSI,VSSB)
LVDSVSS	I	Ground	MIPI/ MDDI Ground (VSSAM)
VDD_18V	O	Analog Output	Internal Power Supply for Digital Logic Circuits. Connect to a stabilizing capacitor. VDD_18V=1.5V (DVDD)

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Signal	I/O	PAD Type (Voltage Level)	Function
LVDSVDD	O	Analog Output	Internal Power Supply for MIPI/ MDDI. Connect to a stabilizing capacitor. (MVDDA)
VDDP	O	Analog Output	LDO output for MIPI YX use(LPDT). VDDP=1.2V(Typical) (MVDDL)
VREF	O	Analog Output	Reference Voltage Connect to a stabilizing capacitor. VREF=2.0V (VREF_PWR)
DIOPWR	O	Analog Output	Internal voltage regulator output for Dual I/O. DIOPWR=1.8V or 1.2V Must connect a capacitor for stabilizing . Please refer to VSEL pin description. - Let it open if Dual I/O are NOT used
Charge Pump/ Booster / Regulator Related pins			
VDDA	O	Analog	Positive Output voltage from the step-up circuit Connect to a stabilizing capacitor. (AVDD)
NVDDA	O	Analog	Negative Output voltage from the step-up circuit Connect to a stabilizing capacitor. (AVEE)
VGH	O	Analog	Positive Output voltage from the step-up circuit
VGHO_L VGHO_R	O	Analog	Positive Power supply to gate control signal and circuit in Panel (VGHO)
VRGH	O	Analog	Regulator output voltage generated from VGH Connect with a stabilizing capacitor.
VGL	O	Analog	Negative Output voltage from the step-up circuit (VGLO,VGLX)
VGL_REG	O	Analog	Regulator output voltage generated from VGL Connect with a stabilizing capacitor.
VGMP	O	Analog	Output voltage generated from from VDDA. It's used for positive gamma voltage. VGMP is applied for GVDD test pin.
VGMN	O	Analog	Output voltage generated from from NVDDA. It's used for negative gamam voltage. VGMN is applied for NGVDD test pin.
VGSP	O	Analog	Dummy Pin
VGSN	O	Analog	Dummy Pin
VCL	O	Analog	Output voltage from the step-up circuit

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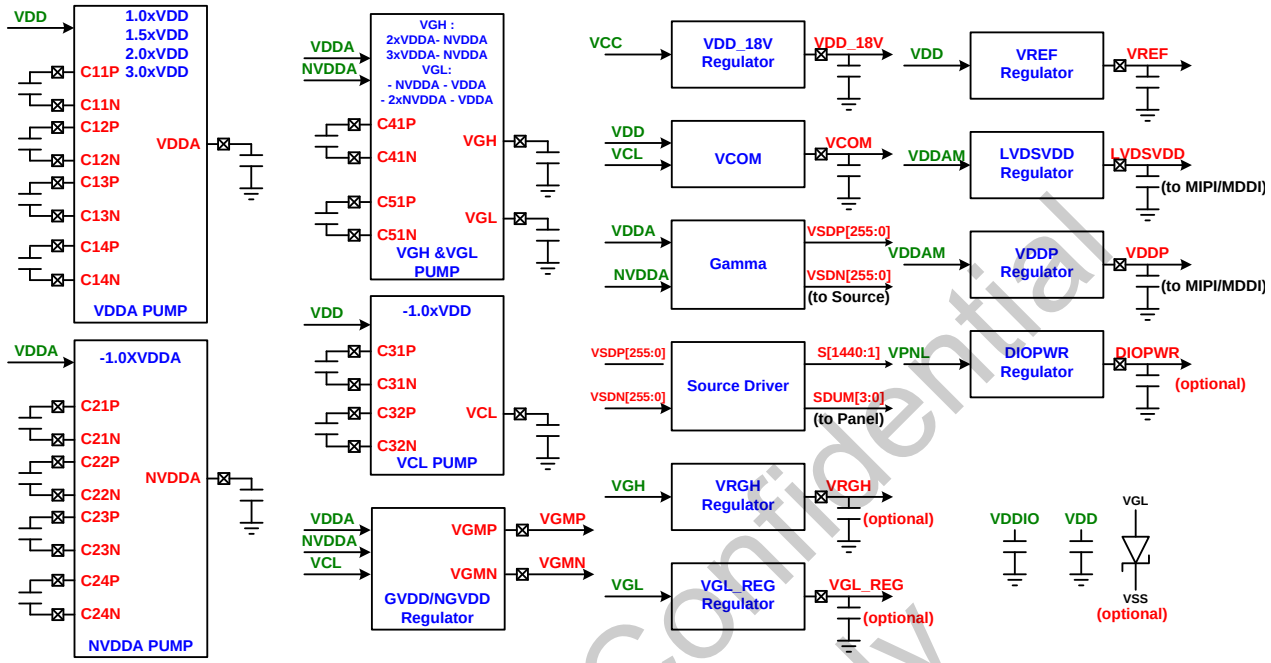
4.2. Power Architecture



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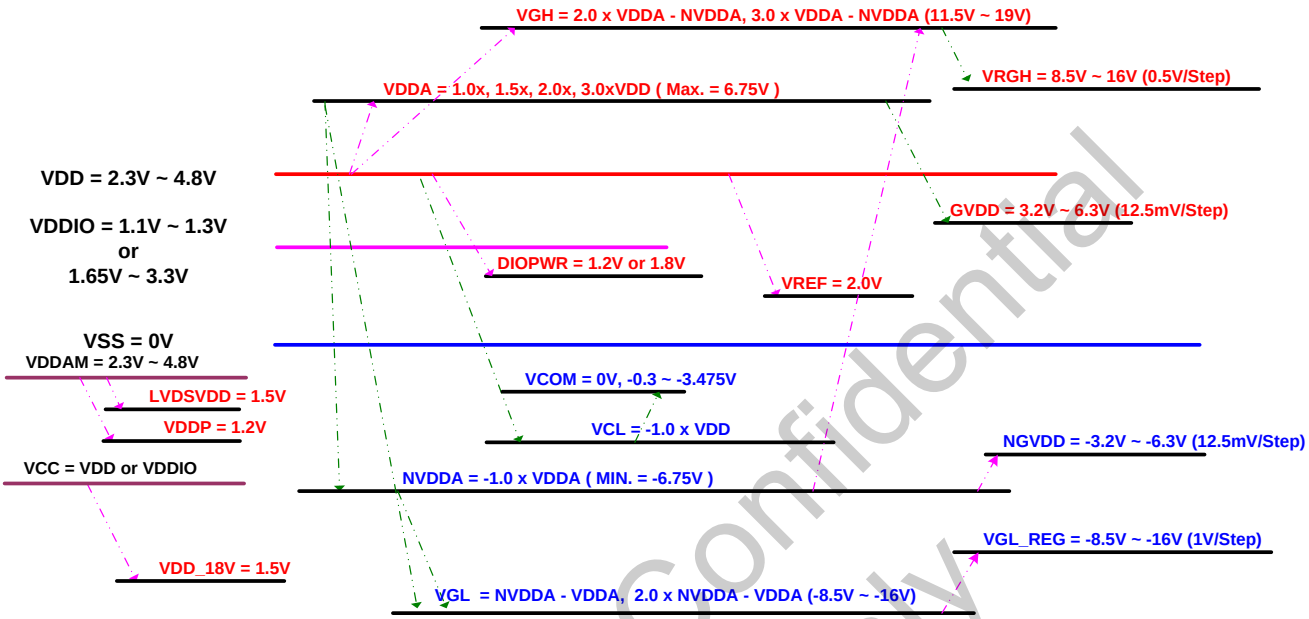
4.3. Power Supply Configuration



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4.4. BOM List

OTM8009A BOM LISTS				
NO.	Signal Name	Value	Max. Ability	Note
1	VDDIO	1.0uF	4V	I/O and Digtal Power
2	VDD	2.2uF	6.3V	Analog Power
3	C11P/C11N	1.0~2.2 uF	6.3V	
4	C12P/C12N	1.0~2.2 uF	6.3V	
5	C13P/C13N	1.0~2.2 uF	6.3V	VDDA Pump
6	C14P/C14N	1.0~2.2 uF	6.3V	
7	VDDA	2.2uF	10V	
8	C21P/C21N	1.0~2.2 uF	6.3V	
9	C22P/C22N	1.0~2.2 uF	6.3V	
10	C23P/C23N	1.0~2.2 uF	6.3V	NVDDA Pump
11	C24P/C24N	1.0~2.2 uF	6.3V	
12	NVDDA	2.2uF	10V	
13	C31P/31N	1.0~2.2 uF	6.3V	
14	C32P/C32N	1.0~2.2 uF	6.3V	VCL Pump
15	VCL	2.2uF	6.3V	
16	C41P/C41N	1.0uF	16V	VGH Pump
17	VGH	1.0uF	25V	
18	C51P/C51N	1.0uF	16V	VGL Pump
19	VGL	1.0uF	20v	
20	VREF	1.0uF	4V	Regulator
21	VCOM	2.2uF	4V	VCOM
22	VDD_18V	2.2uF	4V	TCON Power
23	DIOPWR	1.0uF	4V	BC, TE, RESX Power
24	LVDSVDD	1.0uF	4V	Mipi, RX, DSI Power
25	VDDP	1.0uF	4V	
26	VGL	Schottky Diode		Optional
27	VRGH	1.0uF	20V	Optional
28	VGL_REG	1.0uF	20V	Optional

Note: Gray words is optional and removable.

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5. INSTRUCTIONS

5.1. Outline

The OTM8009A supports high speed serial interface, MIPI, MDDI, to configure system via accessing command register. When the command register is executed, sending the command information to specify which index register would be accessed and following the data to that control register. The MIPI-DSI is compliant with MIPI Alliance Standard for Display Serial Interface(DSI), Version 1.01.00 and D-PHY Version 1.00.00. And command instruction can be accomplished using all supporting system interfaces (MIPI, and I-80 24-bit parallel bus interface).

The OTM8009A has the following major categories of instructions:

(1) System function instructions (User Command Set).

(2) Customer Command List and Description (Manufacturer Command Set / Command 2).

These instructions are asyncrounous to the OTM8009A internal clock, requiring no wait cycles. Because the writing of instruction data does not interfere with the host controller processing, instructions can be handles smoothly and effiencently. The following describes details of instruction settings.

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5.1.1. System function command list and description

Table 5.1 list all the system function command. After the H/W reset by RESX pin or S/W reset by SWRESET command, each internal register becomes default state (Refer “RESET TABLE” section). Commands 10h, 12h, 13h, 20h, 21h, 26h, 28h, 29h, 30h, 33h, 36h (ML parameter only), 38h, and 39h are updated during V-sync when Module is in Sleep Out Mode to avoid abnormal visual effects. During Sleep In mode, these commands are updated immediately. Read Display Power Mode (0Ah), Read Display MADCTR (0Bh), Read Display Pixel Format (0Ch), Read Display Image Mode (0Dh), Read Display Signal Mode (0Eh), and Read Display Self Diagnostic Result (0Fh) of these commands are updated immediately both in Sleep In mode and Sleep Out mode.

Table 5-1 System Function command list

Command	(Hex)	Write/Read/Command	Function	Parameter Number	MIPI Transmissiom Mode
NOP	00	C	No Operation	0	LPDT/HSDT
SWRESET	01	C	Software reset	0	LPDT/HSDT
RDNUMED	05	R	Read Number of the Errors on DSI	1	LPDT/HSDT
RDDPM	0A	R	Read Display Power Mode	1	LPDT/HSDT
RDDMADCTL	0B	R	Read Display MADCTL	1	LPDT/HSDT
RDDCOLMOD	0C	R	Read Display Pixel Format	1	LPDT/HSDT
RDDIM	0D	R	Read Display Image Mode	1	LPDT/HSDT
RDDSM	0E	R	Read Display Signal Mode	1	LPDT/HSDT
RDDSDR	0F	R	Read Display Self Diagnostic Result	1	LPDT/HSDT
SLPIN	10	C	Sleep in	0	LPDT/HSDT
SLPOUT	11	C	Sleep out	0	LPDT/HSDT
PTLON	12	C	Partial Mode On	0	LPDT/HSDT
NORON	13	C	Normal Display Mode On	0	LPDT/HSDT
INVOFF	20	C	Display Inversion Off	0	LPDT/HSDT
INVON	21	C	Display Inversion On	0	LPDT/HSDT
ALLPOFF	22	C	All Pixels Off	0	LPDT/HSDT
ALLPON	23	C	All Pixels On	0	LPDT/HSDT
GAMSET	26	W	Gamma Set	1	LPDT/HSDT
DISPOFF	28	C	Display off	0	LPDT/HSDT
DISPON	29	C	Display on	0	LPDT/HSDT
CASET	2A	W	Column Address Set	4	LPDT/HSDT
PASET	2B	W	Page Address Set	4	LPDT/HSDT
RAMWR	2C	W	Memory Write	Any Length	LPDT/HSDT
RAMRD	2E	R	Memory Read	Any Length	LPDT/HSDT
PLTAR	30	W	Partial area	4	LPDT/HSDT
TEOFF	34	C	Tearing Effect Line Off	0	LPDT/HSDT
TEEON	35	W	Tearing Effect Line On	1	LPDT/HSDT
MADCTL	36	W	Memory Access Control	1	LPDT/HSDT
IDMOFF	38	C	Idle Mode off	0	LPDT/HSDT
IDMON	39	C	Idle Mode on	0	LPDT/HSDT
COLMOD	3A	C	Interface Pixel Format	1	LPDT/HSDT
RAMWRC	3C	W	Memory Write Continue	Any Length	LPDT/HSDT
RAMRDC	3E	R	Memory Read Continue	Any Length	LPDT/HSDT
WRTESCN	44	W	Write TE Scan Line	2	LPDT/HSDT
RDSCNL	45	R	Read Scan Line	2	LPDT/HSDT
WRDISBV	51	W	Write Display Brightness	1	LPDT/HSDT
RDDISBV	52	R	Read Display Brightness Value	1	LPDT/HSDT
WRCTRLD	53	W	Write CTRL Display	1	LPDT/HSDT
RDCTRLD	54	R	Read CTRL Display	1	LPDT/HSDT
WRCABC	55	W	Write Content Adaptive Brightness Control	1	LPDT/HSDT
RDCABC	56	R	Read Content Adaptive Brightness Control	1	LPDT/HSDT
WRCABCMB	5E	W	Write CABC Minimum Brightness	1	LPDT/HSDT
RDCABCMB	5F	R	Read CABC Minimum Brightness	1	LPDT/HSDT
RDABCSDR	68	R	Read Automatic Brightness Control Self-diagnostics Result	1	LPDT/HSDT
RDBWLB	70	R	Read Black/White Low Bits	1	LPDT/HSDT

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RDBKx	71	**R**	Read Bkx	1	LPDT/HSDT
RDBKy	72	**R**	Read Bky	1	LPDT/HSDT
RDWx	73	**R**	Read Wx	1	LPDT/HSDT
RDWy	74	**R**	Read Wy	1	LPDT/HSDT
RDRGLB	75	**R**	Read Red/Green Low Bits	1	LPDT/HSDT
RDRx	76	**R**	Read Rx	1	LPDT/HSDT
RDRy	77	**R**	Read Ry	1	LPDT/HSDT
RDGx	78	**R**	Read Gx	1	LPDT/HSDT
RDGy	79	**R**	Read Gy	1	LPDT/HSDT
RDBALB	7A	**R**	Read Blue/AColour Low Bits	1	LPDT/HSDT
RDBx	7B	**R**	Read Bx	1	LPDT/HSDT
RDBy	7C	**R**	Read By	1	LPDT/HSDT
RDAx	7D	**R**	Read Ax	1	LPDT/HSDT
RDAy	7E	**R**	Read Ay	1	LPDT/HSDT
RDDDBS	A1	**R**	Read DDB Start	5	LPDT/HSDT
RDDDBC	A8	**R**	Read DDB Continue	Any Length	LPDT/HSDT
RDFCS	AA	**R**	Read First Checksum	1	LPDT/HSDT
RDCCS	AF	**R**	Read Continue Checksum	1	LPDT/HSDT
RDID1	DA	**R**	Read ID1	1	LPDT/HSDT
RDID2	DB	**R**	Read ID2	1	LPDT/HSDT
RDID3	DC	**R**	Read ID3	1	LPDT/HSDT

Note：LPDT (Low Power Mode), HSDT (High Speed Mode)

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Table 5-2 command2 list

Command	(Hex)	Write/Read /Command	Function	Parameter Number	MIPI Transmission Mode
ADRSFT	0000	**W**	Address Shift Function	1	LPDT
CMD2_ENA1	FF00	**W**	Enable Access Command2 “CMD2”	3	LPDT
CMD2_ENA2	FF80	**W**	Enable Access Orise Command2	2	LPDT
OTPSEL	A000	**W/R**	OTP Select Region	1	LPDT
MIPISET1	B080	**W/R**	MIPI Setting1	4	LPDT
MIPISET2	B0A1	**W/R**	MIPI Setting2	5	LPDT
IF_PARA1	B280	**W/R**	IF Parameter 1	1	LPDT
IF_PARA2	B282	**W/R**	IF Parameter 2	1	LPDT
PAD_PARA	B390	**W/R**	IOPAD Parameter	3	LPDT
RAMPWRSET	B3C0	**W/R**	SRAM Power Setting	2	LPDT
TSP1	C080	**W/R**	TCON Setting Parameter1	9	LPDT
PTSP1	C092	**W/R**	Panel Timing Setting Parameter1	2	LPDT
PTSP2	C094	**W/R**	Panel Timing Setting Parameter2	1	LPDT
SD_CTRL	C0A2	**W/R**	Source Driver Timing Setting	6	LPDT
P_DRV_M	C0B4	**W/R**	Panel Driving Mode	1	LPDT
OSC_ADJ	C181	**W/R**	Oscillator Adjustment for Idle/Normal Mode	1	LPDT
RGB_VIDEO_SET	C1A1	**W/R**	RGB Video Mode Setting	1	LPDT
SD_PCH_CTRL	C480	**W/R**	Source Driver Precharge Control	9	LPDT
PWR_CTRL1	C580	**W/R**	Power Control Setting 1	4	LPDT
PWR_CTRL2	C590	**W/R**	Power Control Setting 2 for Normal Mode	7	LPDT
PWR_CTRL3	C5A0	**W/R**	Power Control Setting 3 for Idle Mode	7	LPDT
PWR_CTRL4	C5B0	**W/R**	Power Control Setting 4 for DC Voltage Settings	2	LPDT
PWM_PARA1	C680	**W/R**	PWM_PARA1 (C680H) PWM Parameter 1	1	LPDT
PWM_PARA2	C6B0	**W/R**	PWM_PARA2 (C6B0H) PWM Parameter 2	1	LPDT
PWM_PARA3	C6B1	**W/R**	PWM_PARA3 (C6B1H) PWM Parameter 3	1	LPDT
PWM_PARA4	C6B2	**W/R**	PWM_PARA4 (C6B3H) PWM Parameter 4	1	LPDT
PWM_PARA5	C6B3	**W/R**	PWM_PARA5 (C6B4H) PWM Parameter 5	1	LPDT
PWM_PARA6	C6B4	**W/R**	PWM_PARA6 (C6B5H) PWM Parameter 6	1	LPDT
CABCSET1	C700	**W/R**	CABC Setting	1	LPDT
CABCSET2	C800	**W/R**	CABC Gamma Curve Setting	18	LPDT
AIESET	C900	**W/R**	AIE Setting	18	LPDT
PANCTRLSET1	CB80	**W/R**	Panel Control Setting 1	10	LPDT
PANCTRLSET2	CB90	**W/R**	Panel Control Setting 2	15	LPDT
PANCTRLSET3	CBA0	**W/R**	Panel Control Setting 3	15	LPDT
PANCTRLSET4	CBB0	**W/R**	Panel Control Setting 4	10	LPDT
PANCTRLSET5	CBC0	**W/R**	Panel Control Setting 5	15	LPDT
PANCTRLSET6	CBD0	**W/R**	Panel Control Setting 6	15	LPDT
PANCTRLSET7	CBE0	**W/R**	Panel Control Setting 7	10	LPDT
PANCTRLSET8	CBF0	**W/R**	Panel Control Setting 8	10	LPDT
PANU2D1	CC80	**W/R**	Panel U2D Setting 1	10	LPDT
PANU2D2	CC90	**W/R**	Panel U2D Setting 2	15	LPDT
PANU2D3	CCA0	**W/R**	Panel U2D Setting 3	15	LPDT
PAND2U1	CCB0	**W/R**	Panel D2U Setting 1	10	LPDT
PAND2U2	CCC0	**W/R**	Panel D2U Setting 2	15	LPDT
PAND2U3	CCD0	**W/R**	Panel D2U Setting 3	15	LPDT
GOAVST	CE80	**W/R**	GOA VST Setting	12	LPDT
GOAVEND	CE90	**W/R**	GOA VEND Setting	12	LPDT
GOAGPSET	CE9C	**W/R**	GOA Group Setting	2	LPDT
GOACLKA1	CEA0	**W/R**	GOA CLKA1 Setting	7	LPDT
GOACLKA2	CEA7	**W/R**	GOA CLKA2 Setting	7	LPDT
GOACLKA3	CEB0	**W/R**	GOA CLKA3 Setting	7	LPDT

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GOACLKA4	CEB7	**W/R**	GOA CLKA4 Setting	7	LPDT
GOACLKB1	CEC0	**W/R**	GOA CLKB1 Setting	7	LPDT
GOACLKB2	CEC7	**W/R**	GOA CLKB2 Setting	7	LPDT
GOACLKB3	CED0	**W/R**	GOA CLKB3 Setting	7	LPDT
GOACLKB4	CED7	**W/R**	GOA CLKB4 Setting	7	LPDT
GOACLKC1	CF80	**W/R**	GOA CLKC1 Setting	7	LPDT
GOACLKC2	CF87	**W/R**	GOA CLKC2 Setting	7	LPDT
GOACLKC3	CF90	**W/R**	GOA CLKC3 Setting	7	LPDT
GOACLKC4	CF97	**W/R**	GOA CLKC4 Setting	7	LPDT
GOACLKD1	CFA0	**W/R**	GOA CLKD1 Setting	7	LPDT
GOACLKD2	CFA7	**W/R**	GOA CLKD2 Setting	7	LPDT
GOACLKD3	CFB0	**W/R**	GOA CLKD3 Setting	7	LPDT
GOACLKD4	CFB7	**W/R**	GOA CLKD4 Setting	7	LPDT
GOAECLK	CFC0	**W/R**	GOA ECLK Setting	6	LPDT
GOAOPT1	CFC6	**W/R**	GOA Other Options 1	1	LPDT
GOATGOPT	CFC7	**W/R**	GOA Signal Toggle Option Setting	3	LPDT
WRID1	D000	**W/R**	ID1 Setting	1	LPDT
WRID2	D100	**W/R**	ID2/ID3 Setting	2	LPDT
WRDDB	D200	**W/R**	DDB Setting	4	LPDT
EXTCCHK	D300	**R**	EXTC Check	1	LPDT
CESET1	D400	**W/R**	CE Correction Characteristics Setting1	360	LPDT
CESET2	D500	**W/R**	CE Correction Characteristics Setting2	360	LPDT
CEEN	D680	**W/R**	CE Enable	1	LPDT
AIEEN	D700	**W/R**	AIE Enable	1	LPDT
GVDDSET	D800	**W/R**	GVDD/NGVDD Setting	2	LPDT
VCOMDC	D900	**W/R**	VCOM Voltage Setting	1	LPDT
GMCT22P	E100	**W/R**	Gamma Correction Characteristics Setting (2.2 +)	16	LPDT
GMCT22N	E200	**W/R**	Gamma Correction Characteristics Setting (2.2 -)	16	LPDT
GMCT18P	E300	**W/R**	Gamma Correction Characteristics Setting (1.8 +)	16	LPDT
GMCT18N	E400	**W/R**	Gamma Correction Characteristics Setting (1.8 -)	16	LPDT
GMCT25P	E500	**W/R**	Gamma Correction Characteristics Setting (2.5 +)	16	LPDT
GMCT25N	E600	**W/R**	Gamma Correction Characteristics Setting (2.5 -)	16	LPDT
GMCT10P	E700	**W/R**	Gamma Correction Characteristics Setting (1.0 +)	16	LPDT
GMCT10N	E800	**W/R**	Gamma Correction Characteristics Setting (1.0 -)	16	LPDT
NVMIN	EB00	**W**	NV Memory Write Mode	1	LPDT
DGAMR	EC00	**W/R**	Digital Gamma Correction Characteristics Setting (Red)	17	LPDT
DGAMG	ED00	**W/R**	Digital Gamma Correction Characteristics Setting (Green)	17	LPDT
DGAMB	EE00	**W/R**	Digital Gamma Correction Characteristics Setting (Blue)	17	LPDT
PRG_FLAG	F101	**R**	OTP Program flag Check	3	LPDT

Note：LPDT (Low Power Mode), HSDT (High Speed Mode)

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5.2. System Command Description

5.2.1. NOP (00h): No Operation

Address (MIPI)	**00h**										
(MDDI/SPI)	**0x0000**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
NOP	Write		0	0	0	0	0	0	0	0	(00H)
Parameter	No Parameter										-

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	- This command is empty command. It does not have effect on the display module. - However it can be used to terminate RAM data write or read as described in RAMWR (Memory Write), RAMRD (Memory Read) and parameter write commands.
Restriction	-
Register Availability	Status: Availability Normal Mode On, Idle Mode Off, Sleep Out: Yes Normal Mode On, Idle Mode On, Sleep Out: Yes Partial Mode On, Idle Mode Off, Sleep Out: Yes Partial Mode On, Idle Mode On, Sleep Out: Yes Sleep In: Yes
Default	Status: Default Value Power On Sequence: N/A S/W Reset: N/A H/W Reset: N/A

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5.2.2. SWRESET (01h): Software Reset

Address (MIPI)	**01h**										
(MDDI/SPI)	**0x0100**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
SWRESET	Write		0	0	0	0	0	0	0	1	(01H)
Parameter	No Parameter										-

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	- When the Software Reset command is written, it causes a software reset. It resets the commands and parameters to their S/W Reset default values and all source & gate outputs are set to VSS (display off). (See default tables in each command description) Note: The Frame Memory contents are not affected by this command.
Restriction	- It will be necessary to wait 5msec before sending new command following software reset. -The display module loads all display supplier's factory default values to the registers during 5msec. - If Software Reset is applied during Sleep Out mode, it will be necessary to wait *120msec* before sending Sleep Out command. -Software Reset command cannot be sent during Sleep Out sequence.
Register Availability	Status / Availability Normal Mode On, Idle Mode Off, Sleep Out: Yes Normal Mode On, Idle Mode On, Sleep Out: Yes Partial Mode On, Idle Mode Off, Sleep Out: Yes Partial Mode On, Idle Mode On, Sleep Out: Yes Sleep In: Yes
Default	Status / Default Value Power On Sequence: N/A S/W Reset: N/A H/W Reset: N/A

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5.2.3. RDNUMED (05H) Read Number of the Errors on DSI

Address (MIPI)	**05h**										
(MDDI/SPI)	**0x0500**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDNUMED	Write		0	0	0	0	0	1	0	1	(05H)
1st Parameter	Read		P7	P6	P5	P4	P3	P2	P1	P0	-

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	- The first parameter is telling a number of the errors on DSI. The more detailed description of the bits is below. - **P[6.. 0]** bits are telling a number of the errors. - **P[7]** is set to '1' if there is overflow with P[6..0] bits. - **P[7..0]** bits are set to '0's (as well as RDDSM(**0EH**)'s D0 is set '0' at the same time) after there is sent the second parameter information (= The read function is completed). - See Read Display Signal Mode **(0EH**)".
Restriction	
Register Availability	Status / Availability Normal Mode On, Idle Mode Off, Sleep Out: Yes Normal Mode On, Idle Mode On, Sleep Out: Yes Partial Mode On, Idle Mode Off, Sleep Out: Yes Partial Mode On, Idle Mode On, Sleep Out: Yes Sleep In: Yes
Default	Status / Default Value Power On Sequence: 00h S/W Reset: 00h H/W Reset: 00h

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5.2.4. RDDPM (0AH): Read Display Power Mode

Address (MIPI)	0Ah										
(MDDI/SPI)	0x0A00										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDDPM	Write		0	0	0	0	1	0	1	0	(0AH)
1st Parameter	Read		BSTON	IDMON	PTLON	SLP OUT	NOR ON	DISON	D1	D0	08h

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description

-This command indicates the current status of the display as described in the table below:

Bit	Description	Value
BSTON	Booster Voltage Status	"1"=Booster on, "0"=Booster off
IDMON	Idle Mode On/Off	"1" = Idle Mode On, "0" = Idle Mode Off
PTLON	Partial Mode On/Off	"1" = Partial Mode On, "0" = Partial Mode Off
SLPON	Sleep In/Out	"1" = Sleep Out, "0" = Sleep In
NORON	Display Normal Mode On/Off	"1" = Normal Display, "0" = Partial Display
DISON	Display On/Off	"1" = Display On, "0" = Display Off
D1	Not Used	"0"
D0	Not Used	"0"

Restriction

-

Register Availability

Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

Status	Default Value (D7 to D0)
Power On Sequence	08h
S/W Reset	08h
H/W Reset	08h

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5.2.5. RDDMADCTR (0BH): Read Display MADCTR

Address (MIPI)	**0Bh**										
(MDDI/SPI)	**0x0B00**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDDMADCTR	Write		0	0	0	0	1	0	1	1	(0BH)
1st Parameter	Read		MY	MX	MV	ML	RGB	D2	D1	D0	00h

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description

-This command indicates the current status of the display as described in the table below:

Bit	Description	Value
MY	Row Address Order	'1' =Decrement, "0"=Increment
MX	Column Address Order	'1' =Decrement, "0"=Increment
MV	Row/Column Order (MV)	'1' = Row/column exchange (MV=1) '0' = Normal (MV=0)
ML	Vertical Refresh Order	'1' =LCD Refresh Top to Bottom '0' =LCD Refresh Bottom to Top
RGB	RGB/BGR Order	'1' =BGR, "0"=RGB
D2	Not Used	'0'
D1	Not Used	'0'
D0	Not Used	'0'

Restriction

Register Availability

Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

Status	Default Value (D7 to D0)
Power On Sequence	00h
S/W Reset	00h
H/W Reset	00h

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5.2.6. RDDCOLMOD (0CH): Read Display Pixel Format

Address (MIPI)	**0Ch**										
(MDDI/SPI)	**0x0C00**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDDCOLMOD	Write		0	0	0	0	1	1	0	0	(0CH)
1st Parameter	Read		0	0	0	0	0	IFPF2	IFPF1	IFPF0	07h

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description

-This command indicates the current status of the display as described in the table below:

IFPF[2:0]		MCU Interface Color Format
011	3	12-bits/pixel
101	5	16-bits/pixel
110	6	18-bits/pixel
111	7	24-bits/pixel

Others are no define and invalid

Restriction

Register Availability

Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

Status	Default Value
	IFPF[2:0]
Power On Sequence	111 (24-bits/pixel)
S/W Reset	111 (24-bits/pixel)
H/W Reset	111 (24-bits/pixel)

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5.2.7. RDDIM (0DH): Read Display Image Mode

Address (MIPI)	**0Dh**										
(MDDI/SPI)	**0x0D00**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDDIM	Write		0	0	0	0	1	1	0	1	(0DH)
1st Parameter	Read		D7	D6	INVON	ALLPX ON	ALLPX OFF	GCS2	GCS1	GCS0	00h

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description

-This command indicates the current status of the display as described in the table below:

Bit	Description	Value
D7	Not used	
D6	For Future Use	"0" (Not used)
INVON	Inversion On/Off	"1" = Inversion is On, "0" = Inversion is Off
ALLPXON	All Pixel On	"1" = All pixel on is On "0" = All pixel on is Off
ALLPXOFF	All Pixel Off	"1" = All pixel off is On "0" = All pixel off is Off
GCS2	Gamma Curve Selection	"000" = GC0, "001" = GC1, "010" = GC2, "011" = GC3, "100" to "111" = Not defined
GCS1		
GCS0		

Restriction

-

Register Availability

Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

Status	Default Value (D7 to D0)
Power On Sequence	00h
S/W Reset	00h
H/W Reset	00h

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5.2.8. RDDSM (0EH): Read Display Signal Mode

Address (MIPI)	**0Eh**										
(MDDI/SPI)	**0x0E00**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDDSM	Write		0	0	0	0	1	1	1	0	(0EH)
1st Parameter	Read		TEON	TELOM	D5	D4	D3	D2	D1	D0	00h

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description

-This command indicates the current status of the display as described in the table below:

Bit	Description	Value
TEON	Tearing Effect Line On/Off	"1" = On, "0" = Off
TELOM	Tearing effect line mode	"0" = mode1, "1" = mode2
D5	Not Used	
D4	Not Used	
D3	Not Used	
D2	Not Used	
D1	Not Used	
D0	Not Used	

Restriction

Register Availability

Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

Status	Default Value (D7 to D0)
Power On Sequence	00h
S/W Reset	00h
H/W Reset	00h

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5.2.9. RDDSDR (0FH): Read Display Self-Diagnostic Result

Address (MIPI)	**0Fh**										
(MDDI/SPI)	**0x0F00**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDDSDR	Write		0	0	0	0	1	1	1	1	(0FH)
1st Parameter	Read		RELD	FUND	D5	D4	D3	D2	D1	D0	00h

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description

-This command indicates the current status of the display as described in the table below:

Bit	Description	Value
RELD	Register Loading Detection	See section 6.8.1
FUND	Functionality Detection	See section 6.8.2
D5	Not Used	"0"
D4	Not Used	"0"
D3	Not Used	"0"
D2	Not Used	"0"
D1	Not Used	"0"
D0	Not Used	"0"

Restriction

Register Availability

Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

Status	Default Value (D7 to D0)
Power On Sequence	00h
S/W Reset	00h
H/W Reset	00h

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5.2.10. SLPIN (10H): Sleep In

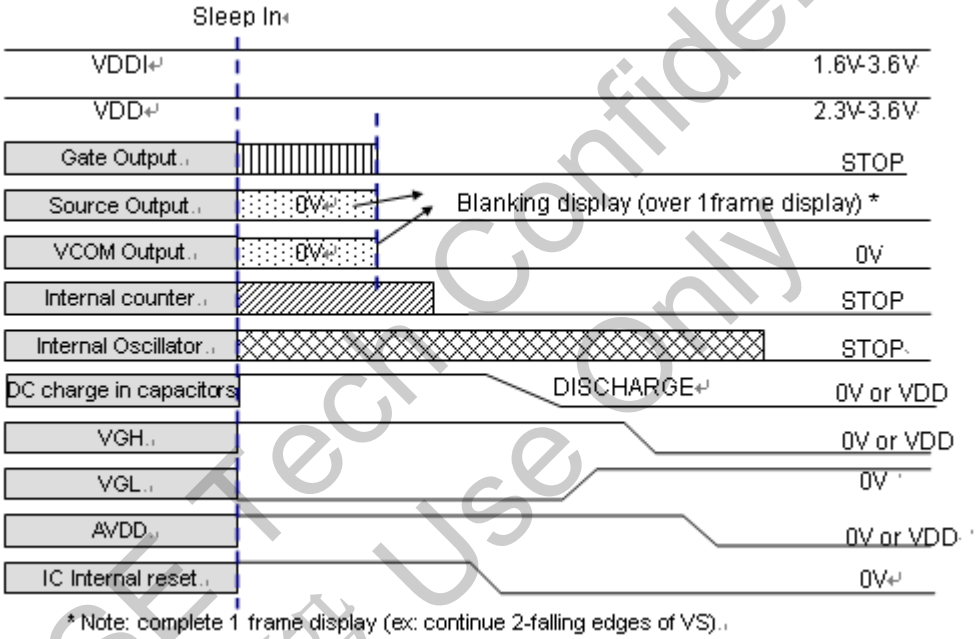
Address (MIPI)	10h										
(MDDI/SPI)	0x1000										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
SLPIN	Write		0	0	0	1	0	0	0	0	(10H)
1st Parameter	No parameter										-

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description

-This command causes the LCD module to enter the minimum power consumption mode.

-In this mode the DC/DC converter is stopped, Internal display oscillator is stopped, and panel scanning is stopped.



-MCU interface and memory are still working and the memory keeps its contents

Restriction

-This command has no effect when module is already in sleep in mode. Sleep In Mode can only be exit by the Sleep Out Command (11H).

-It will be necessary to wait 5msec before sending next command, this is to allow time for the supply voltages and clock circuits to stabilize.

-It will be necessary to wait *120msec* after sending Sleep Out command (when in Sleep In Mode) before Sleep In command can be sent.

Register Availability

Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

Status	Default Value
Power On Sequence	Sleep In mode
S/W Reset	Sleep In mode
H/W Reset	Sleep In mode

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5.2.11. SLPOUT (11H): Sleep Out

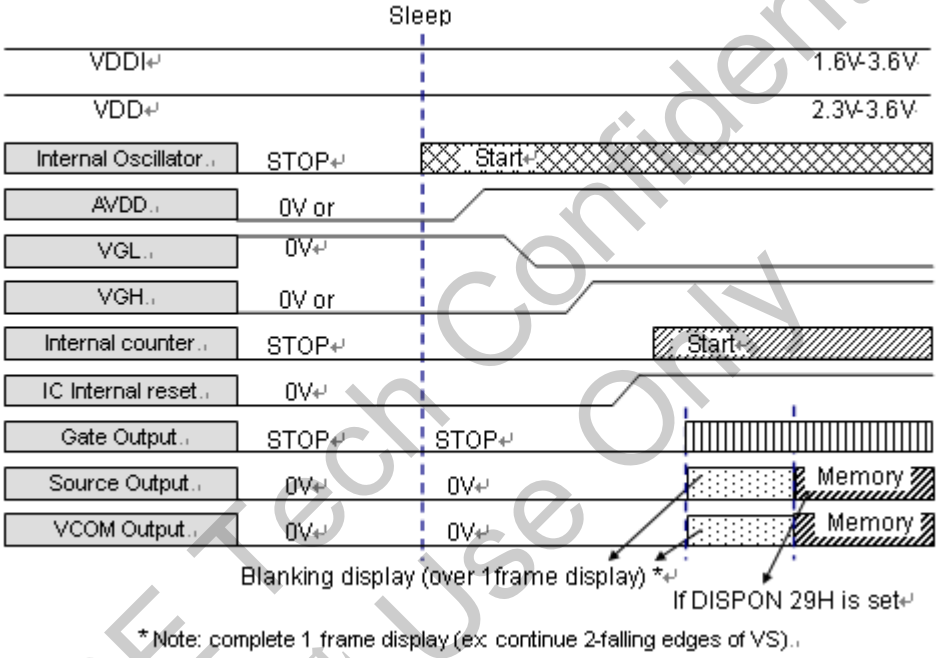
Address (MIPI)	11h										
(MDDI/SPI)	0x1100										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
SLPOUT	Write		0	0	0	1	0	0	0	1	(11H)
1st Parameter	No Parameter										-

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description

-This command turns off sleep mode.

-In this mode the DC/DC converter is enabled, Internal display oscillator is started, and panel scanning is started.



Restriction

-This command has no effect when module is already in sleep out mode. Sleep Out Mode can only be exit by the Sleep In Command (10H).

-It will be necessary to wait *5msec* before sending next command, this is to allow time for the supply voltages and clock circuits to stabilize.

-DRIVER loads all default values of extended and test command to the registers during this 5msec and there cannot be any abnormal visual effect on the display image if those default and register values are same when this load is done and when the DRIVER is already Sleep Out mode.

-DRIVER is doing self-diagnostic functions during this *5msec*.

-It will be necessary to wait *120msec* after sending Sleep In command (when in Sleep Out mode) before Sleep Out command can be sent

Register Availability

Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

Status	Default Value
Power On Sequence	Sleep In mode
S/W Reset	Sleep In mode
H/W Reset	Sleep In mode

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5.2.12. PTLON (12H): Partial Display Mode On

Address (MIPI)	**12h**										
(MDDI/SPI)	**0x1200**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
PTLON	Write		0	0	0	1	0	0	1	0	(12H)
1st Parameter	No Parameter										-

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	-This command turns on Partial mode. The partial mode window is described by the Partial Area command (30H) -To leave Partial mode, the Normal Display Mode On command (13H) should be written. -There is no abnormal visual effect during mode change between Normal mode On <-> Partial mode On.
Restriction	This command has no effect when Partial mode is active.
Register Availability	Status: Normal Mode On, Idle Mode Off, Sleep Out — Availability: Yes Status: Normal Mode On, Idle Mode On, Sleep Out — Availability: Yes Status: Partial Mode On, Idle Mode Off, Sleep Out — Availability: Yes Status: Partial Mode On, Idle Mode On, Sleep Out — Availability: Yes Status: Sleep In — Availability: Yes
Default	Status: Power On Sequence — Default Value: Normal Mode On Status: S/W Reset — Default Value: Normal Mode On Status: H/W Reset — Default Value: Normal Mode On

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5.2.13. NORON (13H): Normal Display Mode On

Address (MIPI)	**13h**										
(MDDI/SPI)	**0x1300**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
NORON	Write		0	0	0	1	0	0	1	1	(13H)
1st Parameter	No Parameter										-

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	-This command returns the display to normal mode. -Normal display mode on means Partial mode off, Scroll mode Off. -Exit from NORON by the Partial mode On command (12H) -There is no abnormal visual effect during mode change from Normal mode On to Partial mode On.
Restriction	-This command has no effect when Normal Display mode is active.
Register Availability	Status / Availability Normal Mode On, Idle Mode Off, Sleep Out / Yes Normal Mode On, Idle Mode On, Sleep Out / Yes Partial Mode On, Idle Mode Off, Sleep Out / Yes Partial Mode On, Idle Mode On, Sleep Out / Yes Sleep In / Yes
Default	Status / Default Value Power On Sequence / Normal Mode On S/W Reset / Normal Mode On H/W Reset / Normal Mode On

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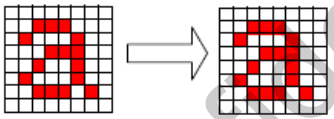
5.2.14. INVOFF (20h) : Display Inversion Off

Address (MIPI)	**20h**									
(MDDI/SPI)	**0x2000**									
	Write/Read	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	Write	0	0	1	0	0	0	0	0	20
Parameter	No parameter									
Description	This command is used to recover from display inversion mode. This command makes no change of contents of frame memory. This command does not change any other status. (Example) memory display  X = Don't care									
Restrictions	This command has no effect when module is already in inversion off mode.									
Register Availability										

Status	Availability
Normal Mode, Idle Mode Off, Sleep Out	Yes
Normal Mode, Idle Mode On, Sleep Out	Yes
Partial Mode, Idle Mode Off, Sleep Out	Yes
Partial Mode, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

Status	Default value
Power On Sequence	Display Inversion Off
SW Reset	Display Inversion Off
HW Reset	Display Inversion Off

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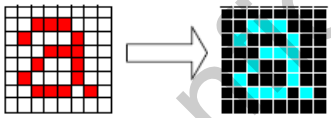
5.2.15. INVON (21h) : Display Inversion On

Address (MIPI)	21h									
(MDDI/SPI)	0x2100									
	Write/Read	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	Write	0	0	1	0	0	0	0	1	21
1st parameter										
Parameter	No parameter									
Description	This command is used to enter into display inversion mode. This command makes no change of contents of frame memory. Every bit is inverted from the frame memory to the display. This command does not change any other status. (Example) memory → display  X = Don't care									
Restrictions	This command has no effect when module is already in inversion on mode.									

Register Availability

Status	Availability
Normal Mode, Idle Mode Off, Sleep Out	Yes
Normal Mode, Idle Mode On, Sleep Out	Yes
Partial Mode, Idle Mode Off, Sleep Out	Yes
Partial Mode, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

Status	Default value
Power On Sequence	Display Inversion Off
SW Reset	Display Inversion Off
HW Reset	Display Inversion Off

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5.2.16. ALLPOFF (22H): All Pixels Off

Address (MIPI)	**22h**										
(MDDI/SPI)	**0x2200**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
ALLPOOFF	Write		0	0	1	0	0	0	1	0	(22H)
1st Parameter	No Parameter										-

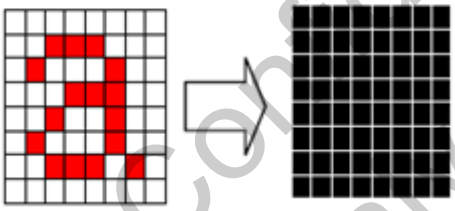
NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description

- This command turns the display panel black in 'Sleep Out' –mode and a status of the 'Display On/Off' –register can be 'on' or 'off'.
- This command makes no change of contents of frame memory (or MIP). This command does not change any other status.

(Example)

Memory (or MIP) display



- 'All Pixels On', 'Normal Display Mode On' or 'Partial Mode On' – commands are used to leave this mode.
- The display panel is showing the content of the frame memory after 'Normal Display Mode On' and 'Partial Mode On' -commands.

Restriction

- This command has no effect when module is already in all pixels off mode.

Register Availability

Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

Status	Default Value
Power On Sequence	Off
S/W Reset	Off
H/W Reset	Off

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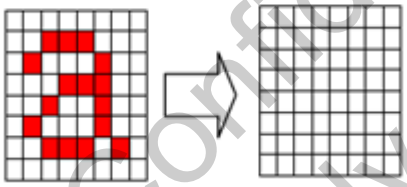
5.2.17. ALLPON (23H): All Pixels On

Address (MIPI)	23h										
(MDDI/SPI)	0x2300										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
ALLPOON	Write		0	0	1	0	0	0	1	1	(23H)
1st Parameter	No Parameter										-

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	- This command turns the display panel white in 'Sleep out ' –mode and a status of the 'Display On/Off' –register can be 'on' or 'off'. - This command makes no change of contents of frame memory (or MIP). - This command does not change any other status. (Example) Memory (or MIP) display  - 'All Pixels Off', 'Normal Display Mode On' or 'Partial Mode On' – commands are used to leave this mode. - The display is showing the content of the frame memory after 'Normal Display Mode On' and 'Partial Mode On' –commands.
Restriction	- This command has no effect when module is already in all pixels on mode.
Register Availability	Status / Availability Normal Mode On, Idle Mode Off, Sleep Out: Yes Normal Mode On, Idle Mode On, Sleep Out: Yes Partial Mode On, Idle Mode Off, Sleep Out: Yes Partial Mode On, Idle Mode On, Sleep Out: Yes Sleep In: Yes
Default	Status / Default Value Power On Sequence: Off S/W Reset: Off H/W Reset: Off

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5.2.18. GAMSET (26H): Gamma Set

Address (MIPI)	26h										
(MDDI/SPI)	0x2600										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
GAMSET	Write		0	0	1	0	0	1	1	0	(26H)
1st Parameter	Write		GC7	GC6	GC5	GC4	GC3	GC2	GC1	GC0	01h

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description

-This command is used to select the desired Gamma curve for the current display. A maximum of 4 curves can be selected. The curve is selected by setting the appropriate bit in the parameter as described in the Table.

GC [7:0]	Parameter	Curve Selected
01h	GC0	Gamma Curve 1 (G2.2)
02h	GC1	Gamma Curve 2 (G1.8)
04h	GC2	Gamma Curve 3 (G2.5)
08h	GC3	Gamma Curve 4 (G1.0)

Note:
1. All other values are undefined.
2. In the Gamma separate mode ignore this command.

Restriction

-Values of GC [7:0] not shown in table above are invalid and will not change the current selected Gamma curve until valid is received.

Register Availability

Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

Status	Default Value
Power On Sequence	01h
S/W Reset	01h
H/W Reset	01h

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5.2.19. DISPOFF (28H): Display Off

Address (MIPI)	28h										
(MDDI/SPI)	0x2800										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
DISPOFF	Write		0	0	1	0	1	0	0	0	(28H)
1st Parameter	No Parameter										-

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description

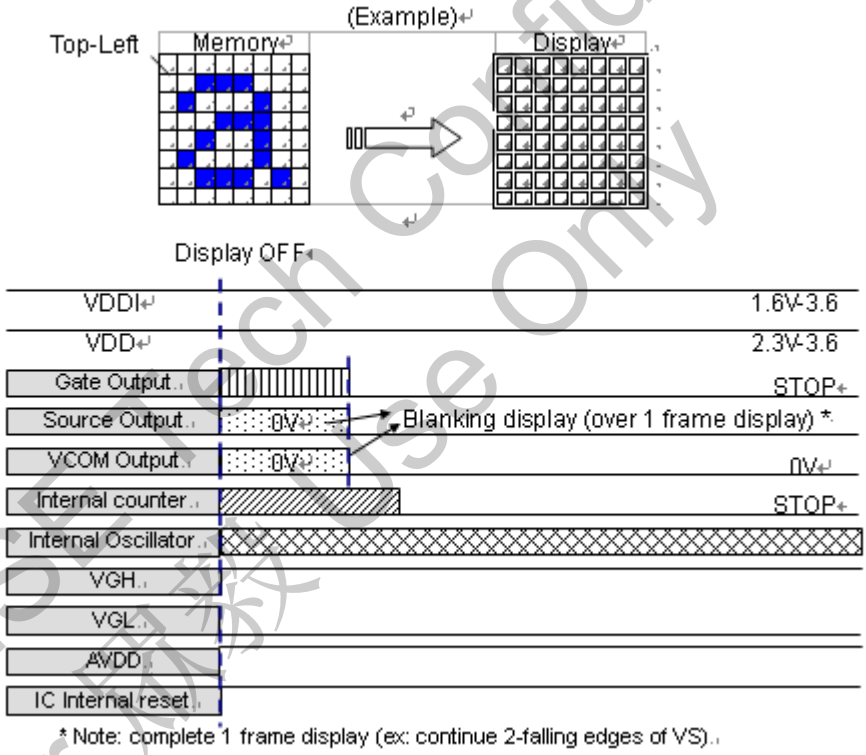
-This command is used to enter into DISPLAY OFF mode. In this mode, the output from Frame Memory is disables and blank page inserted.

-This command makes no change of contents of frame memory.

-This command does not change any other status.

-There will be no abnormal visible effect on the display.

-Exit from this command by Display On (29H)



Restriction

-This command has no effect when module is already in Display Off mode.

Register Availability

Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

Status	Default Value
Power On Sequence	Display off
S/W Reset	Display off
H/W Reset	Display off

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5.2.20. DISPON (29H): Display On

Address (MIPI)	29h										
(MDDI/SPI)	0x2900										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
DISPON	Write		0	0	1	0	1	0	0	1	(29H)
1st Parameter	No Parameter										-

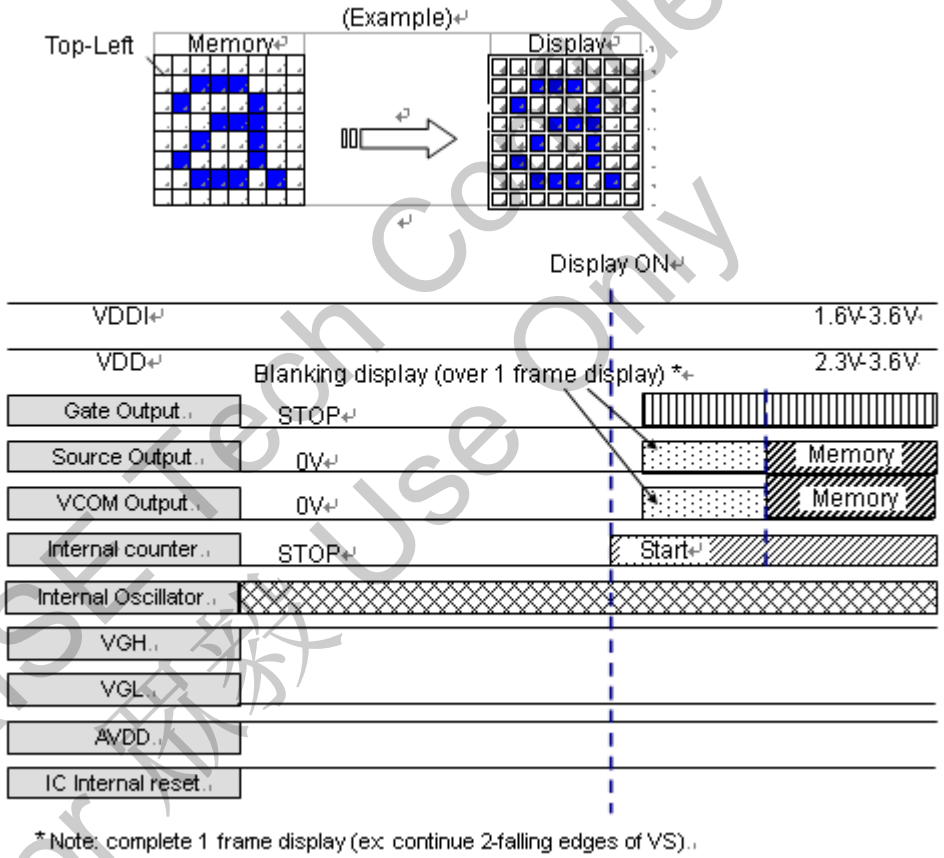
NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description

-This command is used to recover from DISPLAY OFF mode. Output from the Frame Memory is enabled.

-This command makes no change of contents of frame memory.

-This command does not change any other status.



Restriction

-This command has no effect when module is already in Display On mode.

Register Availability

Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

Status	Default Value
Power On Sequence	Display off
S/W Reset	Display off
H/W Reset	Display off

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5.2.21. CASET (2AH): Column Address Set

Address (MIPI)	2Ah										
(MDDI/SPI)	0x2A00 ~ 0x2A03										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
CASET	Write		0	0	1	0	1	0	1	0	(2AH)
1st Parameter	Write		XS15	XS14	XS13	XS12	XS11	XS10	XS9	XS8	00h
2nd Parameter	Write		XS7	XS6	XS5	XS4	XS3	XS2	XS1	XS0	00h
3rd Parameter	Write		XE15	XE14	XE13	XE12	XE11	XE10	XE9	XE8	01h
4th Parameter	Write		XE7	XE6	XE5	XE4	XE3	XE2	XE1	XE0	DFh

NOTE: "-" Don't care, can be set to VDDIO or VSS level

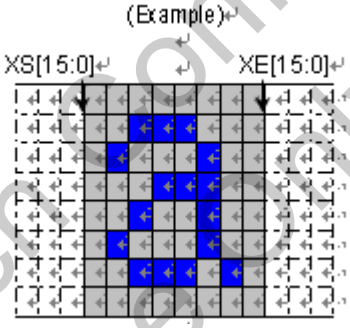
Description

-This command is used to define area of frame memory where MCU can access.

-This command makes no change on the other driver status.

-The value of XS [15:0] and XE [15:0] are referred when RAMWR command comes.

-Each value represents one column line in the Frame Memory.



Restriction

XS [15:0] always must be equal to or less than XE [15:0]

When XS [15:0] or XE [15:0] is greater than maximum address like below, data of out of range will be ignored.

Register Availability

Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

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Default

480x864 Resolution

Status	Default Value		
	XS [15:0]	XE [15:0] (MV='**0**')	XE [15:0] (MV='**1**')
Power On Sequence	0000h	01DFh (479d)	
S/W Reset		01DFh (479d)	035Fh (863d)
H/W Reset		01DFh (479d)	

480x854 Resolution

Status	Default Value		
	XS [15:0]	XE [15:0] (MV='**0**')	XE [15:0] (MV='**1**')
Power On Sequence	0000h	01DFh (479d)	
S/W Reset		01DFh (479d)	0355h (853d)
H/W Reset		01DFh (479d)	

480x800 Resolution (IC Default Setting)

Status	Default Value		
	XS [15:0]	XE [15:0] (MV='**0**')	XE [15:0] (MV='**1**')
Power On Sequence	0000h	01DFh (479d)	
S/W Reset		01DFh (479d)	031Fh (799d)
H/W Reset		01DFh (479d)	

480x720 Resolution

Status	Default Value		
	XS [15:0]	XE [15:0] (MV='**0**')	XE [15:0] (MV='**1**')
Power On Sequence	0000h	01DFh (479d)	
S/W Reset		01DFh (479d)	02CFh (719d)
H/W Reset		01DFh (479d)	

480x640 Resolution

Status	Default Value		
	XS [15:0]	XE [15:0] (MV='**0**')	XE [15:0] (MV='**1**')
Power On Sequence	0000h	01DFh (479d)	
S/W Reset		01DFh (479d)	027Fh (639d)
H/W Reset		01DFh (479d)	

480x480 Resolution

Status	Default Value		
	XS [15:0]	XE [15:0] (MV='**0**')	XE [15:0] (MV='**1**')
Power On Sequence	0000h	01DFh (479d)	
S/W Reset		01DFh (479d)	01DFh (479d)
H/W Reset		01DFh (479d)	

480x360 Resolution

Status	Default Value		
	XS [15:0]	XE [15:0] (MV='**0**')	XE [15:0] (MV='**1**')
Power On Sequence	0000h	01DFh (479d)	
S/W Reset		01DFh (479d)	0167h (359d)
H/W Reset		01DFh (479d)	

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5.2.22. PASET (2BH): Page Address Set

Address (MIPI)	2Bh										
(MDDI/SPI)	0x2B00 ~ 0x2B03										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RASET	Write		0	0	1	0	1	0	1	1	(2BH)
1st Parameter	Write		YS15	YS14	YS13	YS12	YS11	YS10	YS9	YS8	00h
2nd Parameter	Write		YS7	YS6	YS5	YS4	YS3	YS2	YS1	YS0	00h
3rd Parameter	Write		YE15	YE14	YE13	YE12	YE11	YE10	YE9	YE8	03h
4th Parameter	Write		YE7	YE6	YE5	YE4	YE3	YE2	YE1	YE0	60h

NOTE: "-" Don't care, can be set to VDDIO or VSS level

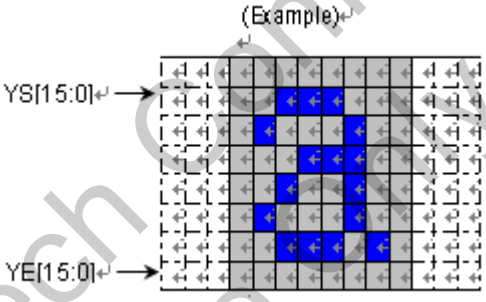
Description

-This command is used to define area of frame memory where MCU can access.

-This command makes no change on the other driver status.

-The value of YS [15:0] and YE [15:0] are referred when RAMWR command comes.

-Each value represents one column line in the Frame Memory.



Restriction

YS [15:0] always must be equal to or less than YE [15:0]

When YS [15:0] or YE [15:0] are greater than maximum row address like below, data of out of range will be ignored.

Register Availability

Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

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Default

480x864 Resolution

Status	Default Value		
	YS [15:0]	YE [15:0] (MV='**0**')	YE [15:0] (MV='**1**')
Power On Sequence	0000h	035Fh (863d)	
S/W Reset		035Fh (863d)	01DFh (479d)
H/W Reset		035Fh (863d)	

480x854 Resolution

Status	Default Value		
	YS [15:0]	YE [15:0] (MV='**0**')	YE [15:0] (MV='**1**')
Power On Sequence	0000h	0355h (853d)	
S/W Reset		0355h (853d)	01DFh (479d)
H/W Reset		0355h (853d)	

480x800 Resolution (IC Default Setting)

Status	Default Value		
	YS [15:0]	YE [15:0] (MV='**0**')	YE [15:0] (MV='**1**')
Power On Sequence	0000h	031Fh (799d)	
S/W Reset		031Fh (799d)	01DFh (479d)
H/W Reset		031Fh (799d)	

480x720 Resolution

Status	Default Value		
	YS [15:0]	YE [15:0] (MV='**0**')	YE [15:0] (MV='**1**')
Power On Sequence	0000h	02CFh (719d)	
S/W Reset		02CFh (719d)	01DFh (479d)
H/W Reset		02CFh (719d)	

480x640 Resolution

Status	Default Value		
	YS [15:0]	YE [15:0] (MV='**0**')	YE [15:0] (MV='**1**')
Power On Sequence	0000h	027Fh (639d)	
S/W Reset		027Fh (639d)	01DFh (479d)
H/W Reset		027Fh (639d)	

480x480 Resolution

Status	Default Value		
	YS [15:0]	YE [15:0] (MV='**0**')	YE [15:0] (MV='**1**')
Power On Sequence	0000h	01DFh (479d)	
S/W Reset		01DFh (479d)	01DFh (479d)
H/W Reset		01DFh (479d)	

480x360 Resolution

Status	Default Value		
	YS [15:0]	YE [15:0] (MV='**0**')	YE [15:0] (MV='**1**')
Power On Sequence	0000h	0167h (359d)	
S/W Reset		0167h (359d)	01DFh (479d)
H/W Reset		0167h (359d)	

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5.2.23. RAMWR (2CH): Memory Write

Address (MIPI)	2Ch										
(MDDI/SPI)	0x2C00										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RAMWR	Write		0	0	1	0	1	1	0	0	(2CH)
1st Parameter	Write		D7	D6	D5	D4	D3	D2	D1	D0	-
|	Write		|	|	|	|	|	|	|	|	|
Nth Parameter	Write		D7	D6	D5	D4	D3	D2	D1	D0	-

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description

-This command is used to transfer data from MCU to frame memory.

-This command makes no change to the other driver status.

-When this command is accepted, the column register and the row register are reset to the Start Column/Start Row positions.

-The Start Column/Start Row positions are different in accordance with MADCTR setting.

-Sending any other command can stop Frame Write.

Restriction

In all color modes, there is no restriction on length of parameters.

480x864 Resolution

480x864x24-bits memory can be written by this command

Memory range: (0000h,0000h) -> (01DFh, 035Fh)

Register Availability

Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

Status	Default Value
Power On Sequence	Contents of memory is set randomly
S/W Reset	Contents of memory is not cleared
H/W Reset	Contents of memory is not cleared

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5.2.24. RAMRD (2EH): Memory Read

Address (MIPI)	2Eh										
(MDDI/SPI)	0x2E00										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RAMRD	Write		0	0	1	0	1	1	1	0	(2EH)
1st Parameter	Read		D7	D6	D5	D4	D3	D2	D1	D0	-
|	Read		|	|	|	|	|	|	|	|	|
(N+1)th Parameter	Read		D7	D6	D5	D4	D3	D2	D1	D0	-

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	-This command is used to transfer data from frame memory to MCU. -This command makes no change to the other driver status. -When this command is accepted, the column register and the row register are reset to the Start Column/Start Row positions. -The Start Column/Start Row positions are different in accordance with MADCTR setting. -Then D[23:0] is read back from the frame memory and the column register and the row register incremented. -Frame Read can be canceled by sending any other command. .
Restriction	-In all color modes, the Frame Read is always 24-bits and there is no restriction on length of parameters.
Register Availability	Status / Availability: Normal Mode On, Idle Mode Off, Sleep Out: Yes Normal Mode On, Idle Mode On, Sleep Out: Yes Partial Mode On, Idle Mode Off, Sleep Out: Yes Partial Mode On, Idle Mode On, Sleep Out: Yes Sleep In: Yes
Default	Status / Default Value: Power On Sequence: Contents of memory is set randomly S/W Reset: Contents of memory is not cleared H/W Reset: Contents of memory is not cleared

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5.2.25. PTLAR (30H): Partial Area

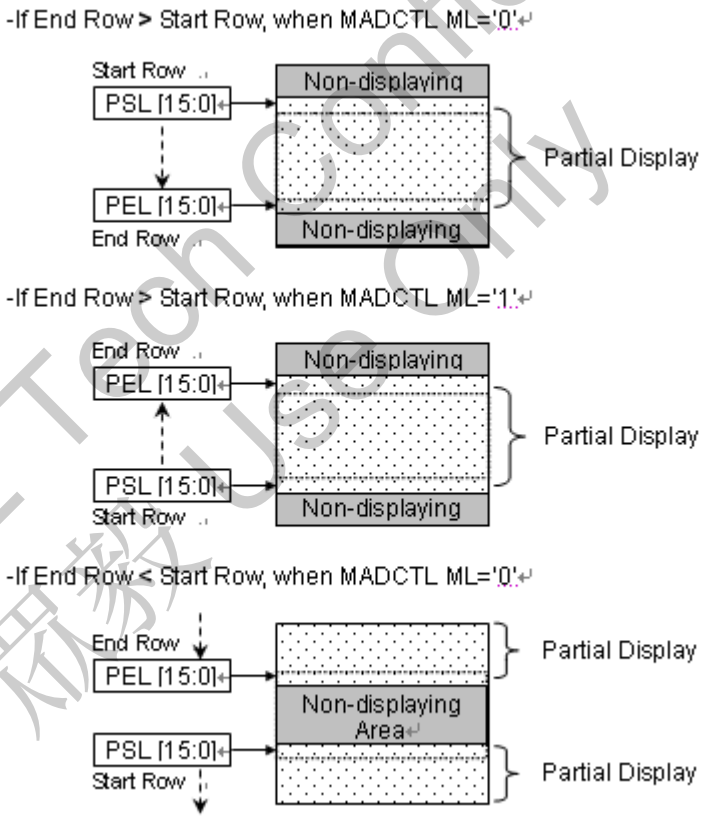
Address (MIPI)	30h										
(MDDI/SPI)	0x3000 ~ 0x3003										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
PTLAR	Write		0	0	1	1	0	0	0	0	(30H)
1st Parameter	Write		PSL15	PSL14	PSL13	PSL12	PSL11	PSL10	PSL9	PSL8	00h
2nd Parameter	Write		PSL7	PSL6	PSL5	PSL4	PSL3	PSL2	PSL1	PSL0	00h
3rd Parameter	Write		PEL15	PEL14	PEL13	PEL12	PEL11	PEL10	PEL9	PEL8	
4th Parameter	Write		PEL7	PEL6	PEL5	PEL4	PEL3	PEL2	PEL1	PEL0	

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description

-This command defines the partial mode's display area.

-There are 4 parameters associated with this command, the first defines the Start Row (PSL) and the second the End Row (PEL), as illustrated in the figures below. PSL and PEL refer to the Frame Memory row address counter.



-If End Row = Start Row then the Partial Area will be one row deep.

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Restriction	-PEL [15:0] always must be equal to or less than PSL [15:0] -When PEL [15:0] or PSL [15:0] are greater than maximum row address like below, data of out of range will be ignored. 480x864 memory base (Parameter range: 0d ≤ PSL [15:0] ≤ PEL [15:0] ≤ 863d (35Fh)) If the "PSL" or "PEL" are large then 863d, it become 863d

Register Availability

Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

480x864 memory base

Status	Default Value	
	PSL [15:0]	PEL [15:0]
Power On Sequence	0000h	035Fh
S/W Reset		
H/W Reset		

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5.2.26. TEOFF (34H): Tearing Effect Line OFF

Address (MIPI)	**34h**										
(MDDI/SPI)	**0x3400**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
TEOFF	Write		0	0	1	1	0	1	0	0	(34H)
1st Parameter	No Parameter										-

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	-This command is used to turn OFF (Active Low) the Tearing Effect output signal from the TE signal line.
Restriction	-This command has no effect when Tearing Effect output is already OFF.
Register Availability	

Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

Status	Default Value
Power On Sequence	OFF
S/W Reset	
H/W Reset	

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5.2.27. TEON (35H): Tearing Effect Line ON

Address (MIPI)	35h										
(MDDI/SPI)	0x3500										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
TEON	Write		0	0	1	1	0	1	0	1	(35H)
1st Parameter	Write		0	0	0	0	0	0	0	TELOM	00h

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description

-This command is used to turn ON the Tearing Effect output signal from the TE signal line.

-This output is not affected by changing MADCTR bit ML.

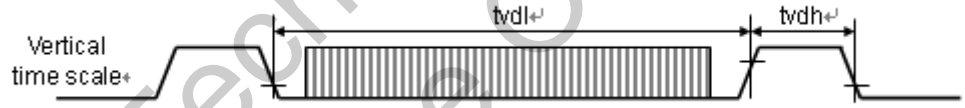
-The Tearing Effect Line On has one parameter, which describes the mode of the Tearing Effect Output Line. ("-"=Don't Care).

—When M='0':

The Tearing Effect Output line consists of V-Blanking information only.

—When M='1':

The Tearing Effect Output line consists of both V-Blanking and H-Blinking information.



Note: During Sleep In Mode with Tearing Effect Line On, Tearing Effect Output pin will be active Low.

Restriction

-This command has no effect when Tearing Effect output is already OFF.

-In MIPI mode, only the Tearing Effect Output line consists of V-Blanking information is available (M='0').

Register Availability

Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

Status	Default Value
Power On Sequence	OFF & TELOM=0
S/W Reset	
H/W Reset	

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5.2.28. MADCTR (36H): Memory Data Access Control

Address (MIPI)	36h										
(MDDI/SPI)	0x3600										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
MADCTR	Write		0	0	1	1	0	1	1	0	(36H)
1st Parameter	Write		MY	MX	MV	ML	RGB	0	0	0	00h

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description

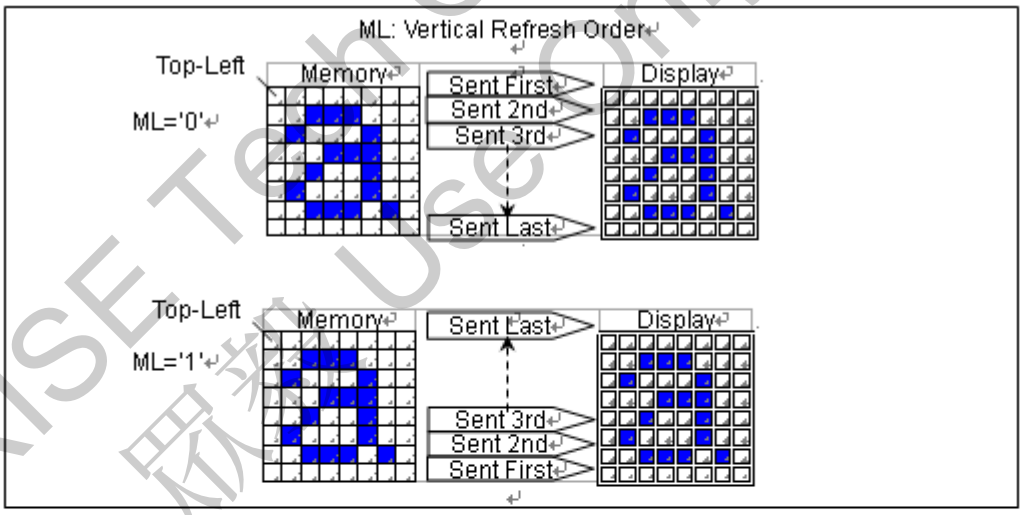
- This command has no effect for driver output, only register value is updated.

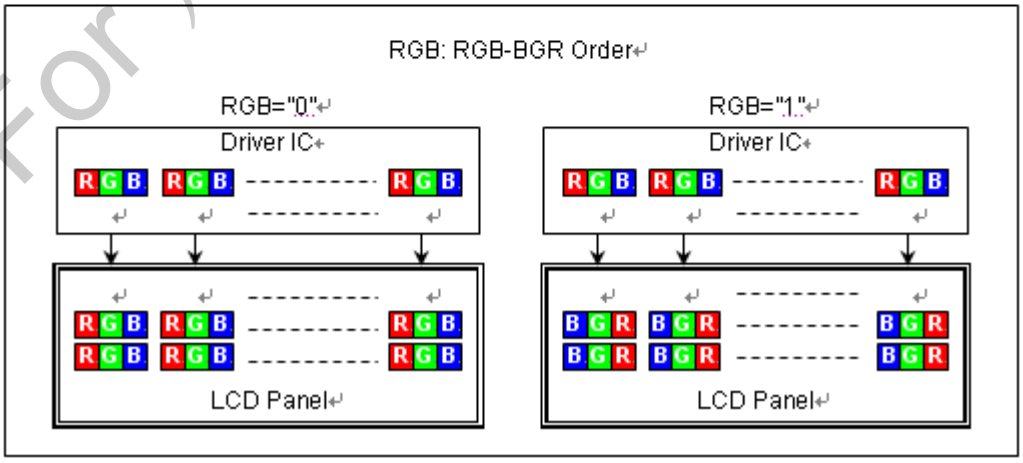
-This command defines read/ write scanning direction of frame memory.

-This command makes no change on the other driver status.

-Bit Assignment

Bit	NAME	DESCRIPTION
MY	Row Address Order	These 3bits controls MCU to memory write/read direction.
MX	Column Address Order	
MV	Row/Column Exchange	
ML	Vertical Refresh Order	LCD vertical refresh direction control '0' = LCD vertical refresh Top to Bottom '1' = LCD vertical refresh Bottom to Top
RGB	RGB-BGR ORDER	Color selector switch control '0' =RGB color filter panel, '1' =BGR color filter panel





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<table>
<tr><td>Restriction</td><td>D2, D1 and D0 of the 1st parameter are set to “00” internally.</td></tr>
<tr><td>Register Availability</td><td>
<table>
<tr><th>Status</th><th>Availability</th></tr>
<tr><td>Normal Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr>
<tr><td>Normal Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr>
<tr><td>Sleep In</td><td>Yes</td></tr>
</table>
</td></tr>
<tr><td>Default</td><td>
<table>
<tr><th>Status</th><th>Default Value</th></tr>
<tr><td>Power On Sequence</td><td>MY=0,MX=0,MV=0,ML=0,RGB=0,</td></tr>
<tr><td>S/W Reset</td><td>MY=0,MX=0,MV=0,ML=0,RGB=0,</td></tr>
<tr><td>H/W Reset</td><td>MY=0,MX=0,MV=0,ML=0,RGB=0,</td></tr>
</table>
</td></tr>
</table>

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5.2.29. IDMOFF (38H): Idle Mode Off

Address (MIPI)	**38h**										
(MDDI/SPI)	**0x3800**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
IDMOFF	Write		0	0	1	1	1	0	0	0	(38H)
1st Parameter	No Parameter										-

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	-This command is used to recover from Idle mode on. -There will be no abnormal visible effect on the display mode change transition. -In the idle off mode, 1. LCD can display 4k, 65k, 262k and 16.7M –colors. 2. Normal frame frequency is applied.
Restriction	-This command has no effect when module is already in idle off mode.
Register Availability	Status / Availability Normal Mode On, Idle Mode Off, Sleep Out: Yes Normal Mode On, Idle Mode On, Sleep Out: Yes Partial Mode On, Idle Mode Off, Sleep Out: Yes Partial Mode On, Idle Mode On, Sleep Out: Yes Sleep In: Yes
Default	Status / Default Value Power On Sequence: Idle Mode Off S/W Reset: Idle Mode Off H/W Reset: Idle Mode Off

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5.2.30. IDMON (39H): Idle Mode On

Address (MIPI)	39h										
(MDDI/SPI)	0x3900										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
IDMON	Write		0	0	1	1	1	0	0	1	(39H)
1st Parameter	No Parameter										-

NOTE: "-" Don't care, can be set to VDDIO or VSS level

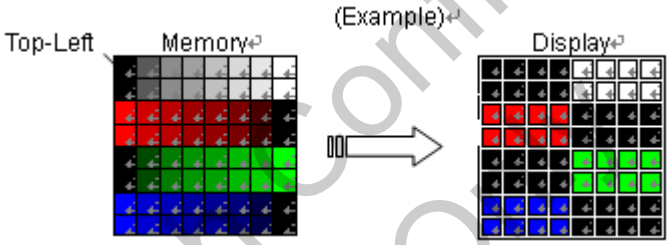
Description

-This command is used to enter into Idle mode on.

-There will be no abnormal visible effect on the display mode change transition.

-In the idle on mode,

1. Color expression is reduced. The primary and the secondary colors using MSB of each R,G and B in the Frame Memory, 8 color depth data is displayed.
2. 8-Color mode frame frequency is applied.
3. Exit from IDMON by Idle Mode Off (38H) command



"x" Don't care

Color	R_7 R_6 R_5 R_4 R_3 R_2 R_1 R_0	G_7 G_6 G_5 G_4 G_3 G_2 G_1 G_0	B_7 B_6 B_5 B_4 B_3 B_4 B_1 B_0
Black	0xxxxxxx	0xxxxxxx	0xxxxxxx
Blue	0xxxxxxx	0xxxxxxx	1xxxxxxx
Red	1xxxxxxx	0xxxxxxx	0xxxxxxx
Magenta	1xxxxxxx	0xxxxxxx	1xxxxxxx
Green	0xxxxxxx	1xxxxxxx	0xxxxxxx
Cyan	0xxxxxxx	1xxxxxxx	1xxxxxxx
Yellow	1xxxxxxx	1xxxxxxx	0xxxxxxx
White	1xxxxxxx	1xxxxxxx	1xxxxxxx

Restriction

This command has no effect when module is already in idle on mode.

Register Availability

Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

Status	Default Value
Power On Sequence	Idle Mode Off
S/W Reset	Idle Mode Off
H/W Reset	Idle Mode Off

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5.2.31. COLMOD (3AH): Interface Pixel Format

Address (MIPI)	3Ah										
(MDDI/SPI)	0x3A00										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
COLMOD	Write		0	0	1	1	1	0	1	0	(3AH)
1st Parameter	Write		VIPF3	VIPF2	VIPF1	VIPF0	D3	IFPF2	IFPF1	IFPF0	77h

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description

This command is used to define the format of RGB picture data, which is to be transferred via the MCU interface and RGB interface. The formats are shown in the table:

IFPF[2:0]		MCU Interface Color Format
011	3	12-bits/pixel
101	5	16-bits/pixel
110	6	18-bits/pixel
111	7	24-bits/pixel

Others are no define and invalid

VIPF[3:0]		RGB Interface Color Format
0101	5	16-bits/pixel (1-times data transfer)
0110	6	18-bits/pixel (1-times data transfer)
0111	7	24-bits/pixel (1-times data transfer)
1110	14	24-bits/pixel (3-times data transfer)

Others are no define and invalid

Note1: In 12-bits/Pixel, 16-bits/Pixel or 18-bits/Pixel mode, the LUT is applied to transfer data into the Frame Memory.
Note2: When RGB I/F the 12-bit/pixel don't care
Note 3: When VIPF[3:0]="1110",8-bits data width of 3-times transfer is used to transmit 1 pixel data with the 24-bits color depth information.

Restriction

There is no visible effect until the Frame Memory is written to.

Register Availability

Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

Status	Default Value	
	IFPF[2:0]	VIPF[3:0]
Power On Sequence	111 (24-bits/pixel)	0111 (24-bits/pixel)
S/W Reset	111 (24-bits/pixel)	0111 (24-bits/pixel)
H/W Reset	111 (24-bits/pixel)	0111 (24-bits/pixel)

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5.2.32. RAMWRCNT (3CH): Memory Write Continue

Address (MIPI)	3Ch										
(MDDI/SPI)	0x3C00										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RAMWRCNT	Write		0	0	1	1	1	1	0	0	(3CH)
1st Parameter	Write		D7	D6	D5	D4	D3	D2	D1	D0	-
|	Write		|	|	|	|	|	|	|	|	|
Nth Parameter	Write		D7	D6	D5	D4	D3	D2	D1	D0	-

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description

-This command is used to transfer data from MCU to frame memory continuing from the pixel location following the previous **2CH** or **3CH** command

-This command makes no change to the other driver status.

-When this command is accepted, the column register and the row register are not reset to the Start Column/Start Row positions.

-The Start Column/Start Row positions are different in accordance with MADCTR setting.

-Sending any other command can stop Frame Write.

Restriction

In all color modes, there is no restriction on length of parameters.

480x864 memory base

480x864x24-bits memory can be written by this command

Memory range: (0000h,0000h) -> (01DFh, 035Fh)

Register Availability

Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

Status	Default Value
Power On Sequence	Contents of memory is set randomly
S/W Reset	Contents of memory is not cleared
H/W Reset	Contents of memory is not cleared

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5.2.33. RAMRDCNT (3EH): Memory Read Continue

Address (MIPI)	**3Eh**										
(MDDI/SPI)	**0x3E00**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RAMRDCNT	Write		0	0	1	1	1	1	1	0	(3EH)
1st Parameter	Read		D7	D6	D5	D4	D3	D2	D1	D0	-
|	Read		|	|	|	|	|	|	|	|	|
(N+1)th Parameter	Read		D7	D6	D5	D4	D3	D2	D1	D0	-

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	-This command is used to transfer data from frame memory to MCU if there is wanted to continue memory write after **2EH** command. -This command makes no change to the other driver status. -When this command is accepted, the column register and the row register are not reset to the Start Column/Start Row positions. -The Start Column/Start Row positions are different in accordance with MADCTR setting. -Then D[23:0] is read back from the frame memory and the column register and the row register incremented. -Frame Read can be canceled by sending any other command. .
Restriction	-In all color modes, the Frame Read is always 24-bits and there is no restriction on length of parameters.
Register Availability	Status / Availability: Normal Mode On, Idle Mode Off, Sleep Out — Yes Normal Mode On, Idle Mode On, Sleep Out — Yes Partial Mode On, Idle Mode Off, Sleep Out — Yes Partial Mode On, Idle Mode On, Sleep Out — Yes Sleep In — Yes
Default	Status / Default Value: Power On Sequence — Contents of memory is set randomly S/W Reset — Contents of memory is not cleared H/W Reset — Contents of memory is not cleared

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5.2.34. WRTESCN (44H): Write TE Scan Line

Address (MIPI)	**44h**										
(MDDI/SPI)	**0x4400**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
WRTESCN	Write		0	1	0	0	0	1	0	0	(44H)
1st Parameter	Write		N15	N14	N13	N12	N11	N10	N9	N8	-
2nd Parameter	Write		N7	N6	N5	N4	N3	N2	N1	N0	-

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	-This command turns on the display module's TE signal when the display module reaches line N. - When setting N=0, it is equivalent to **35H**, M=0.
Restriction	-The command takes affect with the end of one frame.
Register Availability	Status / Availability Normal Mode On, Idle Mode Off, Sleep Out: Yes Normal Mode On, Idle Mode On, Sleep Out: Yes Partial Mode On, Idle Mode Off, Sleep Out: Yes Partial Mode On, Idle Mode On, Sleep Out: Yes Sleep In: Yes
Default	Status / Default Value Power On Sequence: 0000h S/W Reset: 0000h H/W Reset: 0000h

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5.2.35. RDSCNL (45H): Read Scan Line

Address (MIPI)	**45h**										
(MDDI/SPI)	**0x4500 ~ 0x4501**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDSCNL	Write		0	1	0	0	0	1	0	1	(45H)
1st Parameter	Read		N15	N14	N13	N12	N11	N10	N9	N8	xxh
2nd Parameter	Read		N7	N6	N5	N4	N3	N2	N1	N0	xxh

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	-This read byte returns the current scan line. -The 1st parameter: N line MSB -The 2nd parameter: N line LSB
Restriction	None
Register Availability	Status: Normal Mode On, Idle Mode Off, Sleep Out — Availability: Yes Status: Normal Mode On, Idle Mode On, Sleep Out — Availability: Yes Status: Partial Mode On, Idle Mode Off, Sleep Out — Availability: Yes Status: Partial Mode On, Idle Mode On, Sleep Out — Availability: Yes Status: Sleep In — Availability: Yes
Default	Status: Power On Sequence — Default Value: xxh Status: S/W Reset — Default Value: xxh Status: H/W Reset — Default Value: xxh

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5.2.36. WRDISBV (51H) Write Display Brightness

Address (MIPI)	**51h**										
(MDDI/SPI)	**0x5100**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
WRDISBV	Write		0	1	0	1	0	0	0	1	(51H)
1st Parameter	Write		DBV 7	DBV 6	DBV 5	DBV 4	DBV 3	DBV 2	DBV 1	DBV 0	00 | FF

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	- This command is used to adjust the brightness value of the display. - It should be checked what is the relationship between this written value and output brightness of the display. This relationship is defined on the display module specification. - In principle relationship is that 00h value means the lowest brightness and FFh value means the highest brightness.
Restriction	-
Register Availability	Status: Availability Normal Mode On, Idle Mode Off, Sleep Out: Yes Normal Mode On, Idle Mode On, Sleep Out: Yes Partial Mode On, Idle Mode Off, Sleep Out: Yes Partial Mode On, Idle Mode On, Sleep Out: Yes Sleep In: Yes
Default	Status: Default Value Power On Sequence: 00h S/W Reset: 00h H/W Reset: 00h

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5.2.37. RDDISBV (52H) Read Display Brightness Value

Address (MIPI)	**52h**										
(MDDI/SPI)	**0x5200**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDDISBV	Write		0	1	0	1	0	0	1	0	(52H)
1st Parameter	Read		DBV 7	DBV 6	DBV 5	DBV 4	DBV 3	DBV 2	DBV 1	DBV 0	xxh

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description

- This command returns the brightness value of the display.
- It should be checked what the relationship between this returned value and output brightness of the display. This relationship is defined on the display module specification.
- In principle the relationship is that 00h value means the lowest brightness and FFh value means the highest brightness.
- See command "Write Display Brightness (**51H**)".
- This command can be used to read the brightness value of the display also when Display brightness control is in automatic mode.
- Write CTRL Display (**53H**)" bit DB = '1'.
- **DBV[7:0]** is reset when display is in sleep-in mode.
- **DBV[7:0]** is '0' when bit BCTRL of "Write CTRL Display (**53H**)" command is '0'.
- **DBV[7:0]** is manual set brightness specified with "Write CTRL Display (**53H**)" command when bit BCTRL is '1' and bit A of "Write CTRL Display (**53H**)" command is '0'.

Restriction

Register Availability

Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

Status	Default Value
Power On Sequence	00h
S/W Reset	00h
H/W Reset	00h

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5.2.38. WRCTRLD (53H) Write CTRL Display

Address (MIPI)	53h										
(MDDI/SPI)	0x5300										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
WRCTRLD	Write		0	1	0	1	0	0	1	1	(53H)
1st Parameter	Write		-	-	BCTRL	-	DD	BL	-	-	00 | FF

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description

- This command is used to control ambient light, brightness and gamma settings.

BCTRL：Brightness Control Block On/Off. This bit is always used to switch brightness for display and keyboard.

'0' = Off (Brightness registers are 00h, DBV[7..0] and KBV[7..0])

'1' = On (Brightness registers are active, according to the other parameters.)

DD：Display Dimming

'0' = Display Dimming is off

'1' = Display Dimming is on

BL：Backlight On/Off

'0' = Off (Completely turn off backlight circuit. Control lines must be low.)

'1' = On

- Dimming function is adapted to the brightness registers for display and keyboard when bit BCTRL is changed at DD=1, e.g. BCTRL: 0 -> 1 or 1-> 0.
- When BL bit change from "On" to "Off", backlight is turned off

Restriction

Register Availability

Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

Status	Default Value
Power On Sequence	00h
S/W Reset	00h
H/W Reset	00h

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5.2.39. RDCTRLD (54H) Read CTRL Display

Address (MIPI)	**54h**										
(MDDI/SPI)	**0x5400**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDCTRLD	Write		0	1	0	1	0	1	0	0	(54H)
1st Parameter	Read		-	-	BCTRL	-	DD	BL	-	-	xxh

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description

- This command returns ambient light and brightness control values, see command "9.2.35 Write CTRL Display (**53H**) ".

BCTRL: Brightness Control Block On/Off. This bit is always used to switch brightness for display and keyboard.
'0' = Off
'1' = On

DD: Display Dimming
'0' = Display Dimming is off
'1' = Display Dimming is on

BL: Backlight On/Off, This bit is always controlled by the user
'0' = Off (completely turn off backlight circuit)
'1' = On

Restriction

Register Availability

Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

Status	Default Value
Power On Sequence	00h
S/W Reset	00h
H/W Reset	00h

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5.2.40. WRCABC (55H) Write Content Adaptive Brightness Control

Address (MIPI)	**55h**										
(MDDI/SPI)	**0x5500**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
WRCABD	Write		0	1	0	1	0	1	0	1	(55H)
1st Parameter	Write		-	-	-	-	-	-	C1	C0	xxh

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description

- This command is used to set parameters for image content based adaptive brightness control functionality.
- There is possible to use 4 different modes for content adaptive image functionality, which are defined on a table below.

C1	C0	Function
0	0	Off
0	1	User Interface Image (UI)
1	0	Still Picture (ST)
1	1	Moving Image (MV)

Restriction

Register Availability

Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

Status	Default Value
Power On Sequence	00h
S/W Reset	00h
H/W Reset	00h

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5.2.41. RDCABC (56H) Read Content Adaptive Brightness Control

Address (MIPI)	**56h**										
(MDDI/SPI)	**0x5600**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDCABC	Write		0	1	0	1	0	1	1	0	(56H)
1st Parameter	Read		-	-	-	-	-	-	C1	C0	xxh

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description

- This command is used to read the settings for image content based adaptive brightness control functionality.
- There is possible to use 4 different modes for content adaptive image functionality, which are defined on a table below.

C1	C0	Function
0	0	Off
0	1	User Interface Image (UI)
1	0	Still Picture (ST)
1	1	Moving Image (MV)

Restriction

Register Availability

Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

Status	Default Value
Power On Sequence	00h
S/W Reset	00h
H/W Reset	00h

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5.2.42. WRCABCMB (5EH) Write CABC Minimum Brightness

Address (MIPI)	**5Eh**										
(MDDI/SPI)	**0x5E00**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
WRCABCMB	Write		0	1	0	1	1	1	1	0	(5EH)
1st Parameter	Write		CMB 7	CMB 6	CMB 5	CMB 4	CMB 3	CMB 2	CMB 1	CMB 0	00 | FF

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	- This command is used to set the minimum brightness value of the display for CABC function. - In principle relationship is that 00h value means the lowest brightness for CABC and FFh value means the highest brightness for CABC.
Restriction	-
Register Availability	Status / Availability Normal Mode On, Idle Mode Off, Sleep Out: Yes Normal Mode On, Idle Mode On, Sleep Out: Yes Partial Mode On, Idle Mode Off, Sleep Out: Yes Partial Mode On, Idle Mode On, Sleep Out: Yes Sleep In: Yes
Default	Status / Default Value Power On Sequence: 00h S/W Reset: 00h H/W Reset: 00h

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5.2.43. RDCABCMB (5FH) Read CABC Minimum Brightness

Address (MIPI)	**5Fh**										
(MDDI/SPI)	**0x5F00**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDCABCMB	Write		0	1	0	1	1	1	1	1	(5FH)
1st Parameter	Read		CMB 7	CMB 6	CMB 5	CMB 4	CMB 3	CMB 2	CMB 1	CMB 0	xxh

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	- This command returns the minimum brightness value of CABC function. - In principle the relationship is that 00h value means the lowest brightness and FFh value means the highest brightness. - See command "Write CABC Minimum Brightness (**5EH**)".
Restriction	
Register Availability	Status: Normal Mode On, Idle Mode Off, Sleep Out — Availability: Yes Status: Normal Mode On, Idle Mode On, Sleep Out — Availability: Yes Status: Partial Mode On, Idle Mode Off, Sleep Out — Availability: Yes Status: Partial Mode On, Idle Mode On, Sleep Out — Availability: Yes Status: Sleep In — Availability: Yes
Default	Status: Power On Sequence — Default Value: 00h Status: S/W Reset — Default Value: 00h Status: H/W Reset — Default Value: 00h

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5.2.44. RDPWMSDR (68H) Read Automatic Brightness Control Self-diagnostics Result

Address (MIPI)	**68h**										
(MDDI/SPI)	**0x6800**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDPWMSDR	Write		0	1	1	0	1	0	0	0	(68H)
1st Parameter	Read		D7	D6	0	0	0	0	0	0	x0h

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	- This command indicates the status of the display self-diagnostic results for automatic brightness control after Sleep Out command as described as below: **D7**：Register Loading Detection **D6**：Functionality Detection - When "Read Display Self-Diagnostic Result (**0FH**)" command covers the function for "Read Automatic Brightness Control Self-Diagnostic Result (**68H**)" command, it is not necessary to implement.
Restriction	
Register Availability	
Default	

Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Status	Default Value
Power On Sequence	00h
S/W Reset	00h
H/W Reset	00h

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5.2.45. RDBWLB (70H) Read Back/White Low Bits

Address (MIPI)	**70h**										
(MDDI/SPI)	**0x7000**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDBWLB	Write		0	1	1	1	0	0	0	0	(70H)
1st Parameter	Read		Bkx 1	Bkx 0	Bky 1	Bky 0	Wx 1	Wx 0	Wy 1	Wy 0	xxh

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	- This command returns the lowest bits of black and white color characteristics. Black: **Bkx** and **Bky** White: **Wx** and **Wy**
Restriction	
Register Availability	
Default	

Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Status	Default Value
Power On Sequence	xxh
S/W Reset	xxh
H/W Reset	xxh

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5.2.46. RDBkx (71H) Read Bkx

Address (MIPI)	71h										
(MDDI/SPI)	0x7100										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDBkx	Write		0	1	1	1	0	0	0	1	(71H)
1st Parameter	Read		Bkx 9	Bkx 8	Bkx 7	Bkx 6	Bkx 5	Bkx 4	Bkx 3	Bkx 2	xxh

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	- This command returns the Bkx bits (**Bkx[9:2]**) of black color characteristics.
Restriction	
Register Availability	Status / Availability Normal Mode On, Idle Mode Off, Sleep Out: Yes Normal Mode On, Idle Mode On, Sleep Out: Yes Partial Mode On, Idle Mode Off, Sleep Out: Yes Partial Mode On, Idle Mode On, Sleep Out: Yes Sleep In: Yes
Default	Status / Default Value Power On Sequence: xxh S/W Reset: xxh H/W Reset: xxh

5.2.47. RDBky (72H) Read Bky

Address (MIPI)	72h										
(MDDI/SPI)	0x7200										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDBky	Write		0	1	1	1	0	0	1	0	(72H)
1st Parameter	Read		Bky 9	Bky 8	Bky 7	Bky 6	Bky 5	Bky 4	Bky 3	Bky 2	xxh

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	- This command returns the Bky bits (**Bky[9:2]**) of black color characteristics.
Restriction	
Register Availability	Status / Availability Normal Mode On, Idle Mode Off, Sleep Out: Yes Normal Mode On, Idle Mode On, Sleep Out: Yes Partial Mode On, Idle Mode Off, Sleep Out: Yes Partial Mode On, Idle Mode On, Sleep Out: Yes Sleep In: Yes
Default	Status / Default Value Power On Sequence: xxh S/W Reset: xxh H/W Reset: xxh

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5.2.48. RDWx (73H) Read Wx

Address (MIPI)	73h										
(MDDI/SPI)	0x7300										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDWx	Write		0	1	1	1	0	0	1	1	(73H)
1st Parameter	Read		Wx 9	Wx 8	Wx 7	Wx 6	Wx 5	Wx 4	Wx 3	Wx 2	xxh

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	- This command returns the Wx bits (**Wx[9:2]**) of white color characteristics.
Restriction	
Register Availability	Status: Availability Normal Mode On, Idle Mode Off, Sleep Out: Yes Normal Mode On, Idle Mode On, Sleep Out: Yes Partial Mode On, Idle Mode Off, Sleep Out: Yes Partial Mode On, Idle Mode On, Sleep Out: Yes Sleep In: Yes
Default	Status: Default Value Power On Sequence: xxh S/W Reset: xxh H/W Reset: xxh

5.2.49. RDWy (74H) Read Wy

Address (MIPI)	74h										
(MDDI/SPI)	0x7400										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDWy	Write		0	1	1	1	0	1	0	0	(74H)
1st Parameter	Read		Wy 9	Wy 8	Wy 7	Wy 6	Wy 5	Wy 4	Wy 3	Wy 2	xxh

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	- This command returns the Wy bits (**Wy[9:2]**) of white color characteristics.
Restriction	
Register Availability	Status: Availability Normal Mode On, Idle Mode Off, Sleep Out: Yes Normal Mode On, Idle Mode On, Sleep Out: Yes Partial Mode On, Idle Mode Off, Sleep Out: Yes Partial Mode On, Idle Mode On, Sleep Out: Yes Sleep In: Yes
Default	Status: Default Value Power On Sequence: xxh S/W Reset: xxh H/W Reset: xxh

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5.2.50. RDRGLB (75H) Read Red/Green Low Bits

Address (MIPI)	**75h**										
(MDDI/SPI)	**0x7500**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDRGLB	Write		0	1	1	1	0	1	0	1	(75H)
1st Parameter	Read		Rx 1	Rx 0	Ry 1	Ry 0	Gx 1	Gx 0	Gy 1	Gy 0	xxh

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	- This command returns the lowest bits of red and green color characteristics. Red: **Rx** and **Ry** Green: **Gx** and **Gy**
Restriction	
Register Availability	Status / Availability Normal Mode On, Idle Mode Off, Sleep Out: Yes Normal Mode On, Idle Mode On, Sleep Out: Yes Partial Mode On, Idle Mode Off, Sleep Out: Yes Partial Mode On, Idle Mode On, Sleep Out: Yes Sleep In: Yes
Default	Status / Default Value Power On Sequence: xxh S/W Reset: xxh H/W Reset: xxh

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5.2.51. RDRx (76H) Read Rx

Address (MIPI)	**76h**										
(MDDI/SPI)	**0x7600**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDRx	Write		0	1	1	1	0	1	1	0	(76H)
1st Parameter	Read		Rx 9	Rx 8	Rx 7	Rx 6	Rx 5	Rx 4	Rx 3	Rx 2	xxh

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	- This command returns the Rx bits (**Rx[9:2]**) of red color characteristics.
Restriction	
Register Availability	Status / Availability Normal Mode On, Idle Mode Off, Sleep Out / Yes Normal Mode On, Idle Mode On, Sleep Out / Yes Partial Mode On, Idle Mode Off, Sleep Out / Yes Partial Mode On, Idle Mode On, Sleep Out / Yes Sleep In / Yes
Default	Status / Default Value Power On Sequence / xxh S/W Reset / xxh H/W Reset / xxh

5.2.52. RDRy (77H) Read Ry

Address (MIPI)	**77h**										
(MDDI/SPI)	**0x7700**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDRy	Write		0	1	1	1	0	1	1	1	(77H)
1st Parameter	Read		Ry 9	Ry 8	Ry 7	Ry 6	Ry 5	Ry 4	Ry 3	Ry 2	xxh

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	- This command returns the Ry bits (**Ry[9:2]**) of red color characteristics.
Restriction	
Register Availability	Status / Availability Normal Mode On, Idle Mode Off, Sleep Out / Yes Normal Mode On, Idle Mode On, Sleep Out / Yes Partial Mode On, Idle Mode Off, Sleep Out / Yes Partial Mode On, Idle Mode On, Sleep Out / Yes Sleep In / Yes
Default	Status / Default Value Power On Sequence / xxh S/W Reset / xxh H/W Reset / xxh

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5.2.53. RDGx (78H) Read Gx

Address (MIPI)	**78h**										
(MDDI/SPI)	**0x7800**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDGx	Write		0	1	1	1	1	0	0	0	(78H)
1st Parameter	Read		Gx 9	Gx 8	Gx 7	Gx 6	Gx 5	Gx 4	Gx 3	Gx 2	xxh

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	- This command returns the Gx bits (**Gx[9:2]**) of green color characteristics.
Restriction	
Register Availability	Status: Normal Mode On, Idle Mode Off, Sleep Out — Availability: Yes Status: Normal Mode On, Idle Mode On, Sleep Out — Availability: Yes Status: Partial Mode On, Idle Mode Off, Sleep Out — Availability: Yes Status: Partial Mode On, Idle Mode On, Sleep Out — Availability: Yes Status: Sleep In — Availability: Yes
Default	Status: Power On Sequence — Default Value: xxh Status: S/W Reset — Default Value: xxh Status: H/W Reset — Default Value: xxh

5.2.54. RDGy (79H) Read Gy

Address (MIPI)	**79h**										
(MDDI/SPI)	**0x7900**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDGy	Write		0	1	1	1	1	0	0	1	(79H)
1st Parameter	Read		Gy 9	Gy 8	Gy 7	Gy 6	Gy 5	Gy 4	Gy 3	Gy 2	xxh

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	- This command returns the Gy bits (**Gy[9:2]**) of green color characteristics.
Restriction	
Register Availability	Status: Normal Mode On, Idle Mode Off, Sleep Out — Availability: Yes Status: Normal Mode On, Idle Mode On, Sleep Out — Availability: Yes Status: Partial Mode On, Idle Mode Off, Sleep Out — Availability: Yes Status: Partial Mode On, Idle Mode On, Sleep Out — Availability: Yes Status: Sleep In — Availability: Yes
Default	Status: Power On Sequence — Default Value: xxh Status: S/W Reset — Default Value: xxh Status: H/W Reset — Default Value: xxh

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5.2.55. RDBALB (7AH) Read Blue/AColour Low Bits

Address (MIPI)	**7Ah**										
(MDDI/SPI)	**0x7A00**										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDBALB	Write		0	1	1	1	1	0	1	0	(7AH)
1st Parameter	Read		Bx 1	Bx 0	By 1	By 0	Ax 1	Ax 0	Ay 1	Ay 0	xxh

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	- This command returns the lowest bits of blue and A color characteristics. Blue: **Bx** and **By** A: **Ax** and **Ay** - If A is not used **Ax[1:0]** and **Ay[1:0]** bits are set to '0's.
Restriction	
Register Availability	Status / Availability Normal Mode On, Idle Mode Off, Sleep Out: Yes Normal Mode On, Idle Mode On, Sleep Out: Yes Partial Mode On, Idle Mode Off, Sleep Out: Yes Partial Mode On, Idle Mode On, Sleep Out: Yes Sleep In: Yes
Default	Status / Default Value Power On Sequence: xxh S/W Reset: xxh H/W Reset: xxh

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5.2.56. RDBx (7BH) Read Bx

Address (MIPI)	7Bh										
(MDDI/SPI)	0x7B00										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDBx	Write		0	1	1	1	1	0	1	1	(7BH)
1st Parameter	Read		Bx 9	Bx 8	Bx 7	Bx 6	Bx 5	Bx 4	Bx 3	Bx 2	xxh

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	- This command returns the Bx bits (**Bx[9:2]**) of blue color characteristics.
Restriction	
Register Availability	Status: Normal Mode On, Idle Mode Off, Sleep Out — Availability: Yes Status: Normal Mode On, Idle Mode On, Sleep Out — Availability: Yes Status: Partial Mode On, Idle Mode Off, Sleep Out — Availability: Yes Status: Partial Mode On, Idle Mode On, Sleep Out — Availability: Yes Status: Sleep In — Availability: Yes
Default	Status: Power On Sequence — Default Value: xxh Status: S/W Reset — Default Value: xxh Status: H/W Reset — Default Value: xxh

5.2.57. RDBy (7CH) Read By

Address (MIPI)	7Ch										
(MDDI/SPI)	0x7C00										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDBy	Write		0	1	1	1	1	1	0	0	(7CH)
1st Parameter	Read		By 9	By 8	By 7	By 6	By 5	By 4	By 3	By 2	xxh

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	- This command returns the By bits (**By[9:2]**) of blue color characteristics.
Restriction	
Register Availability	Status: Normal Mode On, Idle Mode Off, Sleep Out — Availability: Yes Status: Normal Mode On, Idle Mode On, Sleep Out — Availability: Yes Status: Partial Mode On, Idle Mode Off, Sleep Out — Availability: Yes Status: Partial Mode On, Idle Mode On, Sleep Out — Availability: Yes Status: Sleep In — Availability: Yes
Default	Status: Power On Sequence — Default Value: xxh Status: S/W Reset — Default Value: xxh Status: H/W Reset — Default Value: xxh

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5.2.58. RDAx (7DH) Read Ax

Address (MIPI)	7Dh										
(MDDI/SPI)	0x7D00										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDAx	Write		0	1	1	1	1	1	0	1	(7DH)
1st Parameter	Read		Ax 9	Ax 8	Ax 7	Ax 6	Ax 5	Ax 4	Ax 3	Ax 2	xxh

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	- This command returns the Ax bits (Ax[9:2]) of A color characteristics. - **Ax[9:2]** are set to '0's if they are not used.
Restriction	
Register Availability	Status: Availability Normal Mode On, Idle Mode Off, Sleep Out: Yes Normal Mode On, Idle Mode On, Sleep Out: Yes Partial Mode On, Idle Mode Off, Sleep Out: Yes Partial Mode On, Idle Mode On, Sleep Out: Yes Sleep In: Yes
Default	Status: Default Value Power On Sequence: xxh S/W Reset: xxh H/W Reset: xxh

5.2.59. RDAy (7EH) Read Ay

Address (MIPI)	7Eh										
(MDDI/SPI)	0x7E00										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDAy	Write		0	1	1	1	1	1	1	0	(7EH)
1st Parameter	Read		Ay 9	Ay 8	Ay 7	Ay 6	Ay 5	Ay 4	Ay 3	Ay 2	xxh

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	- This command returns the Ay bits (Ay[9:2]) of A color characteristics. - **Ay[9:2]** are set to '0's if they are not used.
Restriction	
Register Availability	Status: Availability Normal Mode On, Idle Mode Off, Sleep Out: Yes Normal Mode On, Idle Mode On, Sleep Out: Yes Partial Mode On, Idle Mode Off, Sleep Out: Yes Partial Mode On, Idle Mode On, Sleep Out: Yes Sleep In: Yes
Default	Status: Default Value Power On Sequence: xxh S/W Reset: xxh H/W Reset: xxh

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5.2.60. RDDDBSTR (A1H): Read DDB Start

Address (MIPI)	A1h										
(MDDI/SPI)	0xA100 ~ 0xA104										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDDDBSTR	Write		1	0	1	0	0	0	0	1	(A1H)
1st Parameter	Read		ID41 15	ID41 14	ID41 13	ID41 12	ID41 11	ID41 10	ID41 9	ID41 8	01h
2nd Parameter	Read		ID41 7	ID41 6	ID41 5	ID41 4	ID41 3	ID41 2	ID41 1	ID41 0	8Bh
3rd Parameter	Read		ID42 15	ID42 14	ID42 13	ID42 12	ID42 11	ID42 10	ID42 9	ID42 8	80h
4th Parameter	Read		ID42 7	ID42 6	ID42 5	ID42 4	ID42 3	ID42 2	ID42 1	ID42 0	09h
5th Parameter	Read		1	1	1	1	1	1	1	1	FFh

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description

- The command reads identifying and descriptive information from the peripheral. This information is organized in the Device Descriptor Block(DDB) stored on the peripheral.
- The format of returned data is as follows:

Parameter 1: MSB byte of Supplier ID.

Parameter 2: LSB byte of Supplier ID.

Parameter 3: MSB byte of Display module ID.

Parameter 4: LSB byte of Display module ID.

Parameter 5: FFh

The read sequence can be interrupted by any command and it can be continued by **A8H** command.

Restriction

Register Availability

Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

Status	Default Value
Power On Sequence	XXh
S/W Reset	XXh
H/W Reset	XXh

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5.2.61. RDDDBCNT (A8H): Read DDB Continue

Address (MIPI)	A8h										
(MDDI/SPI)	0xA800 ~ 0xA804										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDDDBCNT	Write		1	0	1	0	1	0	0	0	(A8H)
1st Parameter	Read		Idxx nn	Idxx nn	Idxx nn	Idxx nn	Idxx nn	Idxx nn	Idxx nn	Idxx nn	xxh
2nd Parameter	Read		Idxx nn	Idxx nn	Idxx nn	Idxx nn	Idxx nn	Idxx nn	Idxx nn	Idxx nn	xxh
..	Read		-	-	-	-	-	-	-	-	xxh
Nth Parameter	Read		Idxx nn	Idxx nn	Idxx nn	Idxx nn	Idxx nn	Idxx nn	Idxx nn	Idxx nn	xxh

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	- This command returns supplier's identification and display module model/revision information from the point where RDDDBSTR command was interrupted by an other command. - See more on **A1H** command.
Restriction	
Register Availability	Status / Availability Normal Mode On, Idle Mode Off, Sleep Out: Yes Normal Mode On, Idle Mode On, Sleep Out: Yes Partial Mode On, Idle Mode Off, Sleep Out: Yes Partial Mode On, Idle Mode On, Sleep Out: Yes Sleep In: Yes
Default	Status / Default Value Power On Sequence: XXh S/W Reset: XXh H/W Reset: XXh

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5.2.62. RDFCS (AAH): Read First Checksum

Address (MIPI)	AAh										
(MDDI/SPI)	0xAA00										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDFCS	Write		1	0	1	0	1	0	1	0	(AAH)
1st Parameter	Read		FCS 7	FCS 6	FCS 5	FCS 4	FCS 3	FCS 2	FCS 1	FCS 0	xxh

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	- This command returns the first checksum what has been calculated from area registers and the frame memory after the write access to those registers and/or frame memory has been done.
Restriction	- It will be necessary to wait 150ms after there is the last write access on area registers before there can read this checksum value.
Register Availability	Status: Availability Normal Mode On, Idle Mode Off, Sleep Out: Yes Normal Mode On, Idle Mode On, Sleep Out: Yes Partial Mode On, Idle Mode Off, Sleep Out: Yes Partial Mode On, Idle Mode On, Sleep Out: Yes Sleep In: Yes
Default	Status: Default Value Power On Sequence: 00h S/W Reset: 00h H/W Reset: 00h

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5.2.63. RDCCS (AFH): Read Continue Checksum

Address (MIPI)	AFh										
(MDDI/SPI)	0xAF00										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDCCS	Write		1	0	1	0	1	1	1	1	(AFH)
1st Parameter	Read		CCS 7	CCS 6	CCS 5	CCS 4	CCS 3	CCS 2	CCS 1	CCS 0	xxh

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	- This command returns the continue checksum what has been calculated continuously after the first checksum has calculated from area registers and the frame memory after the write access to those registers and/or frame memory has been done.
Restriction	- It will be necessary to wait 300ms after there is the last write access on area registers before there can read this checksum value in the first time.
Register Availability	Status: Normal Mode On, Idle Mode Off, Sleep Out — Availability: Yes Status: Normal Mode On, Idle Mode On, Sleep Out — Availability: Yes Status: Partial Mode On, Idle Mode Off, Sleep Out — Availability: Yes Status: Partial Mode On, Idle Mode On, Sleep Out — Availability: Yes Status: Sleep In — Availability: Yes
Default	Status: Power On Sequence — Default Value: 00h Status: S/W Reset — Default Value: 00h Status: H/W Reset — Default Value: 00h

5.2.64. RDID1 (DAH): Read ID1

Address (MIPI)	DAh										
(MDDI/SPI)	0xDA00										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDID1	Write		1	1	0	1	1	0	1	0	(DAH)
1st Parameter	Read		ID1 7	ID1 6	ID1 5	ID1 4	ID1 3	ID1 2	ID1 1	ID1 0	40h

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	- This read byte identifies the display module's manufacturer.
Restriction	- None
Register Availability	Status: Normal Mode On, Idle Mode Off, Sleep Out — Availability: Yes Status: Normal Mode On, Idle Mode On, Sleep Out — Availability: Yes Status: Partial Mode On, Idle Mode Off, Sleep Out — Availability: Yes Status: Partial Mode On, Idle Mode On, Sleep Out — Availability: Yes Status: Sleep In — Availability: Yes
Default	Status: Power On Sequence — Default Value: 40h Status: S/W Reset — Default Value: 40h Status: H/W Reset — Default Value: 40h

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5.2.65. RDID2 (DBH): Read ID2

Address (MIPI)	DBh										
(MDDI/SPI)	0xDB00										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDID2	Write		1	1	0	1	1	0	1	1	(DBH)
1st Parameter	Read		ID27	ID26	ID25	ID24	ID23	ID22	ID21	ID20	00h

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	- This read byte is used to track the display module/driver version. It is defined by display supplier (with agreement) and changes each time a revision is made to the display, material or construction specifications.
Restriction	- None
Register Availability	Status: Availability Normal Mode On, Idle Mode Off, Sleep Out: Yes Normal Mode On, Idle Mode On, Sleep Out: Yes Partial Mode On, Idle Mode Off, Sleep Out: Yes Partial Mode On, Idle Mode On, Sleep Out: Yes Sleep In: Yes
Default	Status: Default Value Power On Sequence: 00h S/W Reset: 00h H/W Reset: 00h

5.2.66. RDID3 (DCH): Read ID3

Address (MIPI)	DCh										
(MDDI/SPI)	0xDC00										
Inst / Para	Write/Read		D7	D6	D5	D4	D3	D2	D1	D0	(Code)
RDID3	Write		1	1	0	1	1	1	0	0	(DCH)
1st Parameter	Read		ID37	ID36	ID35	ID34	ID33	ID32	ID31	ID30	00h

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description	- This read byte identifies the display module/driver.
Restriction	- None
Register Availability	Status: Availability Normal Mode On, Idle Mode Off, Sleep Out: Yes Normal Mode On, Idle Mode On, Sleep Out: Yes Partial Mode On, Idle Mode Off, Sleep Out: Yes Partial Mode On, Idle Mode On, Sleep Out: Yes Sleep In: Yes
Default	Status: Default Value Power On Sequence: 00h S/W Reset: 00h H/W Reset: 00h

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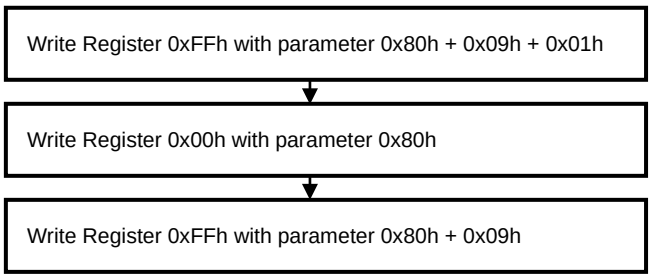
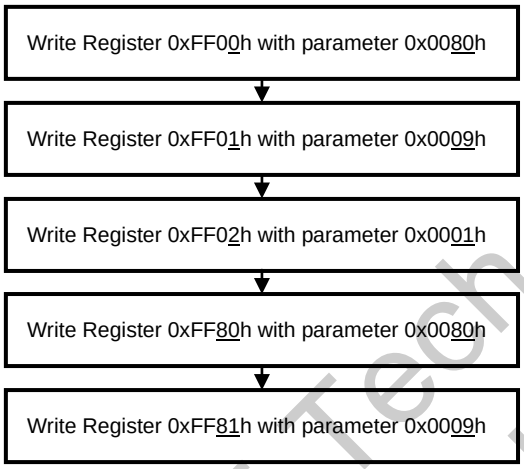
5.3. Customer Command List and Description (Manufacturer Command Set / Command 2)

(1) MIPI IF Enable access command 2 registers:



(2) Other IF Enable access command 2 registers:



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5.3.1. ADRSFT (0000h): Address Shift Function

Address	**00h**										
Address (SPI/I2C/MDDI)	**0000h (0x01st parameter)**										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	0	0	0	0	0	0	0	0	
Parameter	Write		SFT7	SFT6	SFT5	SFT4	SFT3	SFT2	SFT1	SFT0	00h

Description	- Address shift function can be enable when EXTC=1. (EXTC bit at $FF00h) - SFT[7:0] can define the parameter counter number of command 2 register
Default	Status: OTP un-programmed — Default Value: No OTP Support Status: OTP Programmed — Default Value: No OTP Support

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5.3.2. CMD2_ENA1 (FF00h): Enable Access Command 2 & Software EXTC Enable

Address	FFh										
Address (SPI/I2C/MDDI)	FF00h ~ FF02h (0x01st ~ 0x03rd parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	1	1	1	1	1	1	
1st Parameter	Write		PW15	PW14	PW13	PW12	PW11	PW10	PW9	PW8	00h
2nd Parameter	Write		PW7	PW6	PW5	PW4	PW3	PW2	PW1	PW0	00h
3rd Parameter	Write		0	0	0	0	0	0	0	EXTC	00h

Description	- To enter in Command 2 Mode, please let PW[15:8] = 80h and PW[7:0] = 09h - To enable write function of Command 2 & enable parameter shift function, please let EXTC = 1h.
Default	Status: OTP un-programmed — Default Value: No OTP Support Status: OTP Programmed — Default Value: No OTP Support

5.3.3. CMD2_ENA2 (FF80h): Enable Access Orise Command 2

Address	FFh										
Address (SPI/I2C/MDDI)	FF80h ~ FF81h (0x81sh ~ 0x82th parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	1	1	1	1	1	1	
129th Parameter	Write		OPW15	OPW14	OPW13	OPW12	OPW11	OPW10	OPW9	OPW8	00h
130th Parameter	Write		OPW7	OPW6	OPW5	OPW4	OPW3	OPW2	OPW1	OPW0	00h

Description	- To enter in Orise Command 2 Mode, please let OPW[15:8] = 80h and OPW[7:0] = 09h - To enable write function of Command 2 & enable parameter shift function, please let EXTC = 1h.
Default	Status: OTP un-programmed — Default Value: No OTP Support Status: OTP Programmed — Default Value: No OTP Support

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5.3.4. OTPSEL (A000h): Gamma 2.2 OTP Select Region

Address	A0h										
Address (SPI/I2C/MDDI)	A000h (0x01st parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	0	1	0	0	0	0	0	A0h
Parameter	Write/Read		0	0	0	0	0	0	0	reg_gma_otp_sel	00h

Description	Select Gamma 2.2 OTP Region 0：Select Gamma 2.2 OTP Area 1 to program 1：Select Gamma 2.2 OTP Area 2 to program
Default	Status: OTP un-programmed → Default Value: Set as default value Status: OTP Programmed → Default Value: Set as OTP value

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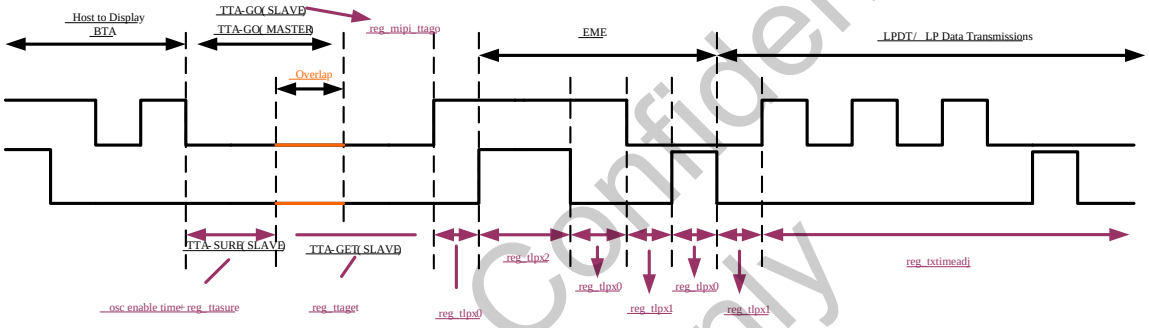
5.3.5. MIPISET1 (B080h): MIPI Setting 1

Address	B0h										
Address (SPI/I2C/MDDI)	B080h ~ B084h (0x81st ~ 0x85th parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	0	1	1	0	0	0	0	B0h
129th Parameter	Write/Read		0	0	0	0	reg_mipi_tlpx0				00h
130th Parameter	Write/Read		reg_mipi_tlpx1				reg_mipi_tlpx2				01h
131st Parameter	Write/Read		0	0	0	0	reg_mipi_txtimeadj				00h
132nd Parameter	Write/Read		reg_mipi_ttago				reg_mipi_ttasure				30h
133rd Parameter	Write/Read		reg_mipi_ttaget								04h

Description



Bit	Description	Value
reg_mipi_tlpx0	Rx lpm state timeout signal	step: 4'h0~4'hF (osc x (1+step))
reg_mipi_tlpx1	Rx lpm state timeout signal	step: 4'h0~4'hF (osc x (1+step))
reg_mipi_tlpx2	RX_to_TX LP11	step: 4'h0~4'hF (osc x (1+step))
reg_mipi_txtimeadj	LPM transmitting time	step: 4'h0~4'hF (osc x (1+step))
reg_mipi_ttago	Tx->Rx BTA timeout signal	step: 4'h0~4'hF (osc x (1+step))
reg_mipi_ttasure	Rx->Tx BTA timeout signal	step: 4'h0~4'hF (osc x (1+step))
reg_mipi_ttaget	Tx BTA settle timeout signal	step: 8'h0~8'hFF (osc x (1+step))

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.6. MIPISET2 (B0B2h): MIPI Setting 2

Address	B0h										
Address (SPI/I2C/MDDI)	B0B2h ~ B0B4h (0xB3rd ~ 0xB5th parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	0	1	1	0	0	0	0	B0h
179th Parameter	Write/Read		0	0	reg_mipi_mp_clk_dly_sel						06h
180th Parameter	Write/Read		0	0	reg_mipi_mp_ch0_dly_sel						00h
181st Parameter	Write/Read		0	0	reg_mipi_mp_ch1_dly_sel						00h

Description

Bit	Description	Value
reg_mipi_mp_clk_dly_sel	MIPI Clock Lane Delay	1step = 30pS
reg_mipi_mp_ch0_dly_sel	MIPI D0 Lane Delay	1step = 30pS
reg_mipi_mp_ch1_dly_sel	MIPI D1 Lane Delay	1step = 30pS

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.7. IF_PARA1 (B280H) IF Parameter 1

Address	B2h										
Address (SPI/I2C/MDDI)	B280h (0x81st parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	0	1	1	0	0	1	0	B2h
129th Parameter	Write/Read		0	0	1	0	0	LUT_IPM[2]	LUT_IPM[1]	LUT_IPM[0]	24h

Description

- **LUT_IPM[2:0] :** This register is used to expand data selection in 16bit mode and 18bit mode.

Data expansion table in case of Green of 16bit Mode and 18bit Mode.

IPM	R[7]	R[6]	R[5]	R[4]	R[3]	R[2]	R[1]	R[0]	
0	D[5]	D[4]	D[3]	D[2]	D[1]	D[0]	0	0	
1	D[5]	D[4]	D[3]	D[2]	D[1]	D[0]	0	1	
2	D[5]	D[4]	D[3]	D[2]	D[1]	D[0]	1	0	
3	D[5]	D[4]	D[3]	D[2]	D[1]	D[0]	1	1	
4	D[5]	D[4]	D[3]	D[2]	D[1]	D[0]	D[5]	D[4]	default
5	D[5]	D[4]	D[3]	D[2]	D[1]	D[0]	D[5]	0	
6	D[5]	D[4]	D[3]	D[2]	D[1]	D[0]	D[5]	1	
7	D[5]	D[4]	D[3]	D[2]	D[1]	D[0]	0	0	

Data expansion table in case of Red and Blue of 16bit Mode.

IPM	R[7]	R[6]	R[5]	R[4]	R[3]	R[2]	R[1]	R[0]	
0	D[4]	D[3]	D[2]	D[1]	D[0]	D[4]	0	0	
1	D[4]	D[3]	D[2]	D[1]	D[0]	D[4]	0	1	
2	D[4]	D[3]	D[2]	D[1]	D[0]	D[4]	1	0	
3	D[4]	D[3]	D[2]	D[1]	D[0]	D[4]	1	1	
4	D[4]	D[3]	D[2]	D[1]	D[0]	D[4]	D[3]	D[2]	default
5	D[4]	D[3]	D[2]	D[1]	D[0]	D[4]	D[4]	0	
6	D[4]	D[3]	D[2]	D[1]	D[0]	D[4]	D[4]	1	
7	D[4]	D[3]	D[2]	D[1]	D[0]	D[4]	0	0	

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.8. IF_PARA2 (B282H) IF Parameter 2

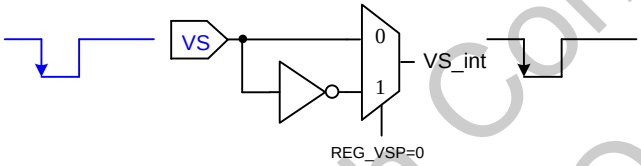
Address	B2h										
Address (SPI/I2C/MDDI)	B282h (0x83st parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	0	1	1	0	0	1	0	
131th Parameter	Write/Read		RGB_VSP	RGB_HSP	RGB_DP	RGB_EP	0	0	RGB_updata_freq[1]	RGB_updata_freq[0]	00h

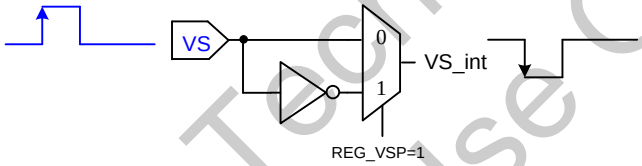
Description

- This command is used to set RGB IF Function.

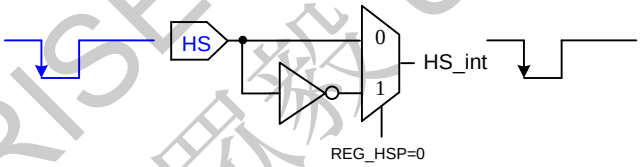
Symbol	Name	Clock polarity set for RGB Interface
REG_VSP	Vsync polarity set	'1' = High level sync clock '0' = Low level sync clock
REG_HSP	Hsync polarity set	'1' = High level sync clock '0' = Low level sync clock
REG_DP	PCLK polarity set	'1' = data fetched at the falling edge '0' = data fetched at the rising edge
REG_EP	Enable polarity set	'1' = Low enable for RGB interface '0' = High enable for RGB interface

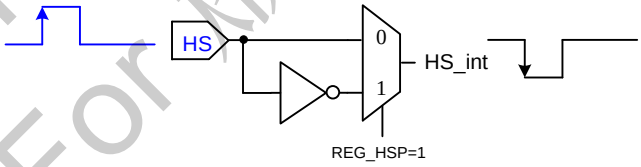
REG_VSP



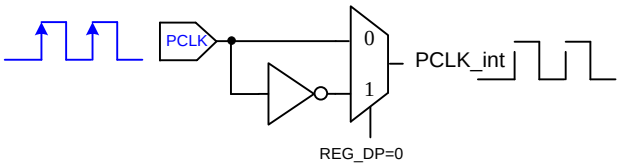


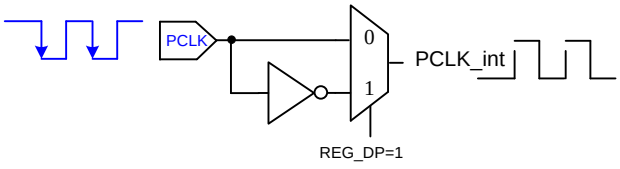
REG_HSP





REG_DP





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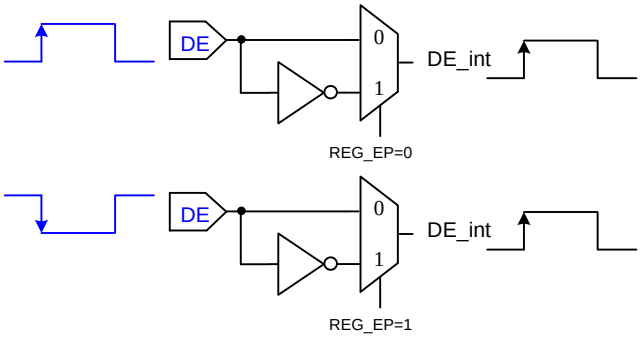
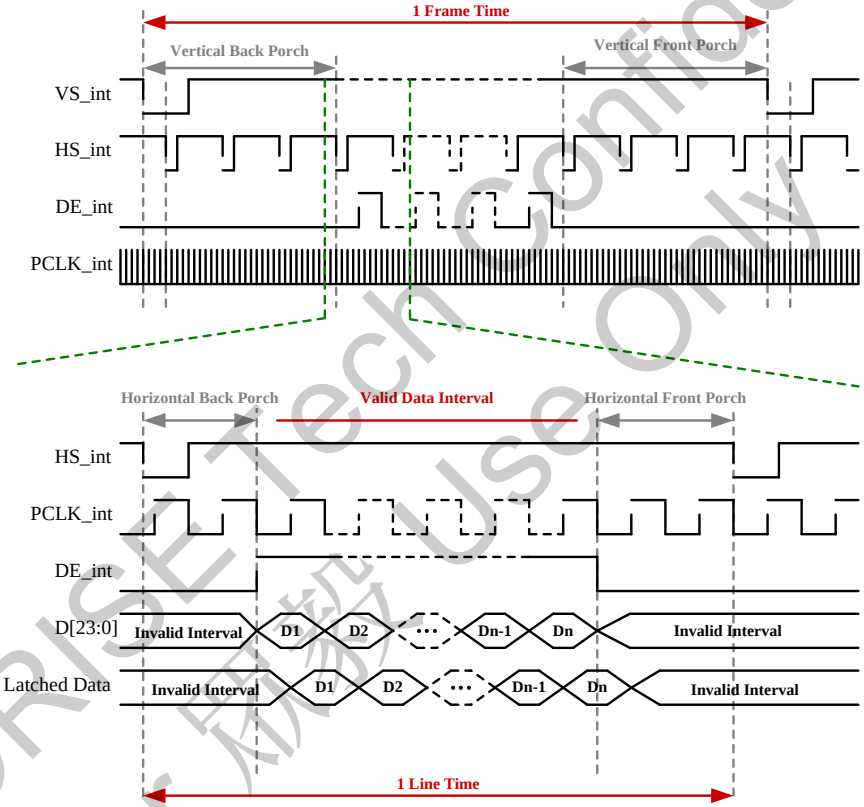
REG_EP



-When RGB_VSP=0 ; RGB_HSP=0 ; RGB_DP=0 ; RGB_EP=0



- **RGB_UPDATA_FREQ[1:0] :** User could set frequency of RAM update from interface.

RGB_UPDAT_FREQ[1:0]	Frequency(Frame)
00	1
01	2
10	3
11	4

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.9. PAD_PARA (B390H) IOPAD Parameter

Address	B3h										
Address (SPI/I2C/MDDI)	B390h ~ B392(0x91st ~ 0x93rd parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	0	1	1	0	0	1	1	
145th Parameter	Write/Read		SW_IM [3]	SW_IM [2]	SW_IM [1]	SW_IM [0]	0	SW_GM [2]	SW_GM [1]	SW_GM [0]	00h
146th Parameter	Write/Read		SW_SM X	SW_SM Y	SW_SR GB	0	0	0	SW_I2C SA[1]	SW_I2C SA[0]	00h
147th Parameter	Write/Read		SW_EXP EN[3]	SW_EXP EN[2]	SW_EXP EN[1]	SW_EXP EN[0]	0	1	0	1	05h

Description

- These registers are used to replace the Hardware PIN. Use **SW_EXPEN[3:0]** to enable Software control.

- SW_IM[3:0] : When SW_EXPEN[3] = 1 **,** this setting replace the Hardware PIN IM.

SW_EXPEN[3]	Interface Select
0	Pin_IM[3:0]
1	SW_IM[3:0]

- SW_GM[2:0] : When SW_EXPEN[2] = 1 **,** this setting is valid.

SW_EXPEN[2]	Resolution
0	480 x 800
1	SW_GM[2:0]

SW_GM[2:0]	Resolution	SW_GM[2:0]	Resolution
000	480 x 800	100	480 x 720
001	480 x 864	101	480 x 640
010	480 x 854	110	480 x 480
011	480 x 800	111	480 x 360

- SW_SMX/SW_SMY/SW_SRGB/SW_I2C_SA[1:0]

Bit	Description	Value
SW_SMX	Row address order	0 : Write/Read RAM Direction from Left to Right 1 : Write/Read RAM Direction from Right to Left ※ The fucnction only can be applied when SW_EXPEN[1] = 1. If SW_EXPEN[1] = 0, The Write/Read RAM Direction is Left to Rgiht.
SW_SMY	Column address order	0 : Write/Read RAM Direction from Up to Down 1 : Write/Read RAM Direction from Down to Up ※ The fucnction only can be applied when SW_EXPEN[1] = 1. If SW_EXPEN[1] = 0, The Write/Read RAM Direction is Up to Down.
SW_SRGB	RGB-BGR Order	0 : For RGB filter panel 1 : For BGR filter panel ※ The fucnction only can be applied when SW_EXPEN[1] = 1. If SW_EXPEN[1] = 0, The order is RGB.
SW_I2C_SA[1:0]	Slave address at I2C I/F	00 : 1001100 01 : 1001101 10 : 1001100 11 : 1001101 ※ The fucnction only can be applied when SW_EXPEN[0] = 1.

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.10. PANSET (B3A6h): Panel Type Setting

Address	B3h										
Address (SPI/I2C/MDDI)	B3A6h ~B3A7h (0xA7th ~0xA8th parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	0	1	1	0	0	1	1	
167th Parameter	Write/Read		0	0	1	0	ZIG_SET	1	1	1	2Fh
168th Parameter	Write/Read		0	0	0	0	0	0	0	ZIG_OPT	00h

Description

- These registers are used to control panel type

ZIGOPT	ZIGSET	Panel Type
0	X	Normal Panel
1	0	Normal Panel
	1	Pseudo-dot Panel

X: Don't care

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.11. RAMPWRSET (B3C0h): SRAM Power Setting

Address	B3h										
Address (SPI/I2C/MDDI)	B3C0h ~B3C1h (0xC1st ~0xC2rd parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	0	1	1	0	0	1	1	
193rd Parameter	Write/Read		0	0	0	RAMOFF[1:0]		RAMOFF_TEST[2:0]			09h
194th Parameter	Write/Read		rampwron_mddi_spi	rampwron_mddi_i2c	0	rampwron_mipi	0	rampwron_rgb	0	rampwron_cpu	00h

Description

Bit	Description	Value
RAMOFF[1:0]	Turn off SRAM power condition	2'b00：Turn off SRAM power only when reset keeps low 2'b01：Turn off SRAM power when reset keeps low or Ultra Low Power Mode in sleep-in 2'b10：Turn off SRAM power when reset keeps low or sleep-in
RAMOFF_TEST[2:0]	SRAM power test mode. Orsie use only	3'b001
rampwron_mddi_spi	Force turn on SRAM power during mddi_spi IF mode	1: Turn on SRAM power during sleep in mode when IM = 0110 and 1110 0: Refer to RAMOFF[1:0]
rampwron_mddi_i2c	Force turn on SRAM power during mddi_i2c mode	1: Turn on SRAM power during sleep in mode when IM = X111 0: Refer to RAMOFF[1:0]
rampwron_mipi	Force turn on SRAM power during mipi IF mode	1: Turn on SRAM power during sleep in mode when IM = X101 0: Refer to RAMOFF[1:0]
rampwron_rgb	Force turn on SRAM power during rgb IF mode	1: Turn on SRAM power during sleep in mode when IM = X011, X100 0: Refer to RAMOFF[1:0]
rampwron_cpu	Force turn on SRAM power during cpu IF mode	1: Turn on SRAM power during sleep in mode when IM = X000, X001 and X010 0: Refer to RAMOFF[1:0]

Note: X = Don't care

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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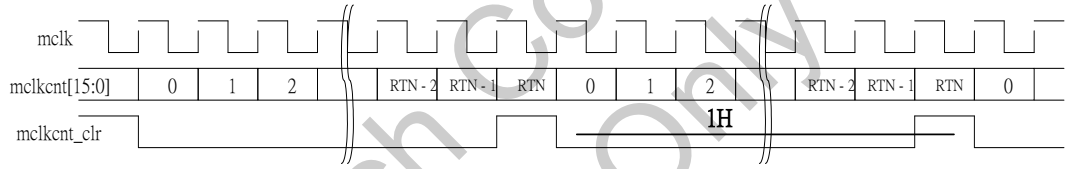
5.3.12. TSP1(C080h) TCON Setting Parameter 1

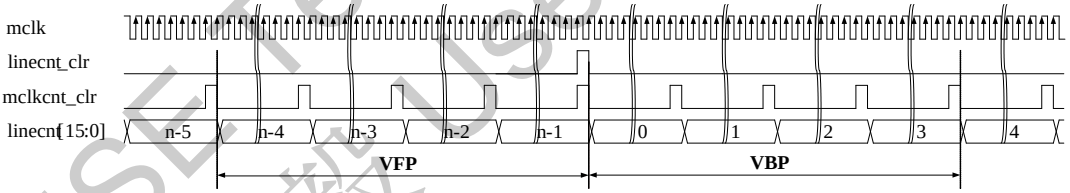
Address	C0h										
Address (SPI/I2C/MDDI)	C080h ~ C088h (0x81st ~ 0x89th parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	0	0	0	0	C0h
129th Parameter	Write/Read		rtn[15]	rtn[14]	rtn[13]	rtn[12]	rtn[11]	rtn[10]	rtn[9]	rtn[8]	00h
130th Parameter	Write/Read		rtn[7]	rtn[6]	rtn[5]	rtn[4]	rtn[3]	rtn[2]	rtn[1]	rtn[0]	5Fh
131st Parameter	Write/Read		vfp[15]	vfp[14]	vfp[13]	vfp[12]	vfp[11]	vfp[10]	vfp[9]	vfp[8]	00h
132nd Parameter	Write/Read		vfp[7]	vfp[6]	vfp[5]	vfp[4]	vfp[3]	vfp[2]	vfp[1]	vfp[0]	10h
133rd Parameter	Write/Read		vbp[7]	vbp[6]	vbp[5]	vbp[4]	vbp[3]	vbp[2]	vbp[1]	vbp[0]	10h
134th Parameter	Write/Read		pwrseq_rtn[15]	pwrseq_rtn[14]	pwrseq_rtn[13]	pwrseq_rtn[12]	pwrseq_rtn[11]	pwrseq_rtn[10]	pwrseq_rtn[9]	pwrseq_rtn[8]	00h
135th Parameter	Write/Read		pwrseq_rtn[7]	pwrseq_rtn[6]	pwrseq_rtn[5]	pwrseq_rtn[4]	pwrseq_rtn[3]	pwrseq_rtn[2]	pwrseq_rtn[1]	pwrseq_rtn[0]	5Fh
136th Parameter	Write/Read		pwrseq_vfp[7]	pwrseq_vfp[6]	pwrseq_vfp[5]	pwrseq_vfp[4]	pwrseq_vfp[3]	pwrseq_vfp[2]	pwrseq_vfp1]	pwrseq_vfp[0]	10h
137th Parameter	Write/Read		pwrseq_vbp[7]	pwrseq_vbp[6]	pwrseq_vbp[5]	pwrseq_vbp[4]	pwrseq_vbp[3]	pwrseq_vbp[2]	pwrseq_vbp[1]	pwrseq_vbp[0]	10h

Description

- RTN is used to set the cycles of mclk for one line.



- VFP is used to set Vertical front porch ; VBP is used to set Vertical back porch.



- 129th ~ 133rd parameters are used during normal display period; 134th ~ 137th parameters are used for power–on sequence period.

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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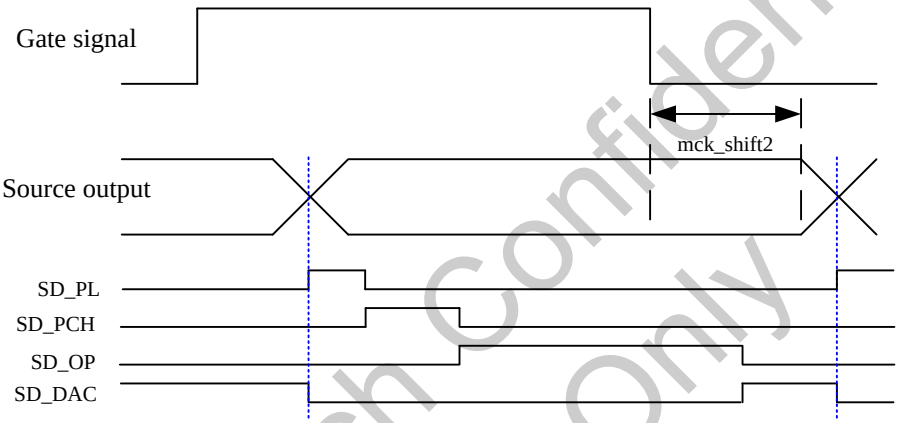
5.3.13. PTSP1(C092h) Panel Timing Setting Parameter 1

Address	C0h										
Address (SPI/I2C/MDDI)	C092h ~ C093h (0x93st ~ 0x94nd parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	0	0	0	0	C0h
147th Parameter	Write/Read		mck_shift2[15]	mck_shift2[14]	mck_shift2[13]	mck_shift2[12]	mck_shift2[11]	mck_shift2[10]	mck_shift2[9]	mck_shift2[8]	00h
148th Parameter	Write/Read		mck_shift2[7]	mck_shift2[6]	mck_shift2[5]	mck_shift2[4]	mck_shift2[3]	mck_shift2[2]	mck_shift2[1]	mck_shift2[0]	10h

Description

- mck_shift2 is used to control the hold timing of source output



mck_shift2[15:0]	time unit (mclk)
0000h	1
0001h	2
0002h	3
...	...
FFFFh	65536

- For SD_PL/SD_PCH/SD_OP/SD_DAC, please refer to SD_CTRL(C0A1h)

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.14. PTSP2 (C094h) Panel Timing Setting Parameter 2

Address	C0h										
Address (SPI/I2C/MDDI)	C094h ~ C095h (0x95st ~ 0x96nd parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	0	0	0	0	C0h
149th Parameter	Write/Read		mck_ shift3[15]	mck_ shift3[14]	mck_ shift3[13]	mck_ shift3[12]	mck_ shift3[11]	mck_ shift3[10]	mck_ shift3[9]	mck_ shift3[8]	00h
150th Parameter	Write/Read		mck_ shift3[7]	mck_ shift3[6]	mck_ shift3[5]	mck_ shift3[4]	mck_ shift3[3]	mck_ shift3[2]	mck_ shift3[1]	mck_ shift3[0]	13h

Description

- mck_shift3 is used to control the loda location for latch control
- The difference between mck_shift2 and mck_shift3 must keep three.

mck_shift2[15:0]	time unit (mclk)
0000h	1
0001h	2
0002h	3
…	…
FFFFh	65536

-

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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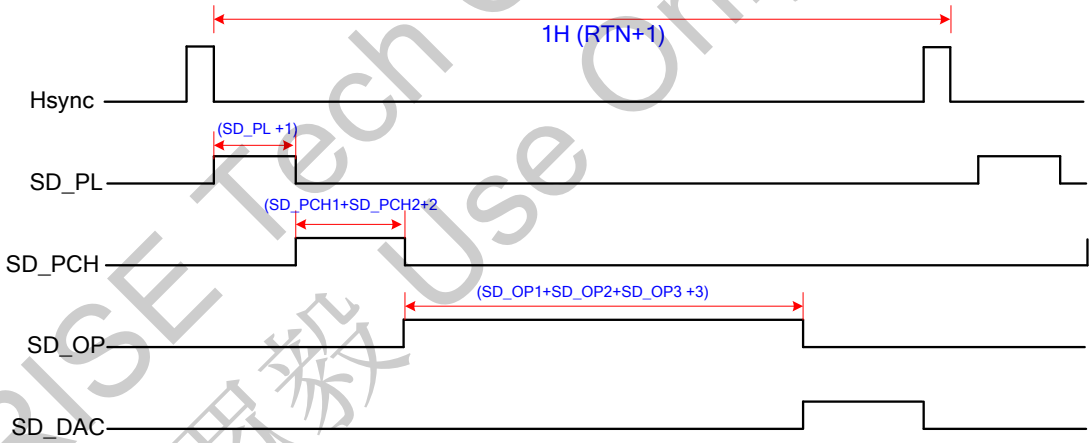
5.3.15. SD_CTRL (C0A2h) Source Driver Timing Setting

Address	C0h										
Address (SPI/I2C/MDDI)	C0A2h ~C0A7h (0xA3rd ~ 0xA8th parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	0	0	0	0	C0h
163rd Parameter	Write/Read		SD_PL [7]	SD_PL [6]	SD_PL [5]	SD_PL [4]	SD_PL [3]	SD_PL [2]	SD_PL [1]	SD_PL [0]	0Dh
164th Parameter	Write/Read		SD_PCH1 [7]	SD_PCH1 [6]	SD_PCH1 [5]	SD_PCH1 [4]	SD_PCH1 [3]	SD_PCH1 [2]	SD_PCH1 [1]	SD_PCH1 [0]	06h
165th Parameter	Write/Read		SD_PCH2 [7]	SD_PCH2 [6]	SD_PCH2 [5]	SD_PCH2 [4]	SD_PCH2 [3]	SD_PCH2 [2]	SD_PCH2 [1]	SD_PCH2 [0]	02h
166th Parameter	Write/Read		SD_OP1 [7]	SD_OP1 [6]	SD_OP1 [5]	SD_OP1 [4]	SD_OP1 [3]	SD_OP1 [2]	SD_OP1 [1]	SD_OP1 [0]	01h
167th Parameter	Write/Read		SD_OP2 [7]	SD_OP2 [6]	SD_OP2 [5]	SD_OP2 [4]	SD_OP2 [3]	SD_OP2 [2]	SD_OP2 [1]	SD_OP2 [0]	3Ch
168th Parameter	Write/Read		SD_OP3 [7]	SD_OP3 [6]	SD_OP3 [5]	SD_OP3 [4]	SD_OP3 [3]	SD_OP3 [2]	SD_OP3 [1]	SD_OP3 [0]	08h

Description

- - This command is used for source driver timing control.

- **SD_PL**: Source Driver Pull Low Timing. Set by (SD_PL[7:0] + 1) MCLK
- **SD_PCH**: Source Driver Pre-charge Timing. Set by (SD_PCH1[7:0] + SD_PCH2[7:0] + 2) MCLK
- **SD_OP**: Source Driver OP ON Timing. Set by (SD_OP1[7:0] + SD_OP2[7:0] + SD_OP3[7:0] + 3)MCLK
- **SD_DAC**: Source Floating State: Set by (RTN - **SD_PL** - **SD_PCH** - **SD_OP** -5)MCLK



Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.16. P_DRV_M(C0B4h) : Panel Driving Mode

Address	C0h										
Address (SPI/I2C/MDDI)	C0B4h (0xB5th parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	0	0	0	0	C0h
181st Parameter	Write/Read		0	INV_MODE[2]	INV_MODE[1]	INV_MODE[0]	0	INV_MODE_IDLE[2]	INV_MODE_IDLE[1]	INV_MODE_IDLE[0]	00h

Description

- This command is used to set the inversion type and mode

181th Parameter	Value	Inversion Mode Selection
INV_MODE[[2:0] (Normal Mode)	000	1 Dot Inversion
	001	1+2 Dot Inversion
	101	Column Inversion
	Others	Reserved
INV_MODE_IDLE[[2:0] (IDLE Mode)	000	1 Dot Inversion
	001	1+2 Dot Inversion
	101	Column Inversion
	Others	Reserved

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.17. OSC_ADJ(C181h) : Oscillator Adjustment for Idle/Normal Mode

Address	C1h										
Address (SPI/I2C/MDDI)	C181h (0x82nd parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	0	0	0	1	C1h
130th Parameter	Write/Read		0	OSC_ IDLE[2]	OSC_ IDLE[0]	OSC_ IDLE[0]	0	OSC_ NORM[2]	OSC_ NORM[1]	OSC_ NORM[0]	55h

Description

- This command is used to set the Oscillator frequency in Normal mode and Idle mode.
- **OSC_IDLE[2:0] : Define Oscillator frequency in Idle mode.**

OSC_IDLE[1:0]	Frame rate
000	35Hz
001	40Hz
010	45Hz
011	50Hz
100	55Hz
101	60Hz
110	65Hz
111	70Hz

-
- **OSC_NORM[2:0] : Define Oscillator frequency in Normal mode.**

OSC_NORM[1:0]	Frame rate
000	35Hz
001	40Hz
010	45Hz
011	50Hz
100	55Hz
101	60Hz
110	65Hz
111	70Hz

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.18. OSC_DIV(C191h) : Oscillator Division

Address	C1h										
Address (SPI/I2C/MDDI)	C191h (0x92nd parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	0	0	0	1	C1h
146th Parameter	Write/Read		PWRSEQ_OSCNUM[1:0]		OSCNUM [1:0]		PCLKNUM_IDLE[1:0]		PCLKNUM_NORM[1:0]		00h

Description

- This command is used to set the Oscillator frequency division in Normal mode and Idle mode.
- **PWRSEQ_OSCNUM[1:0] : Define Oscillator frequency division in power sequence.**

PWRSEQ_OSCNUM[1:0]	Frame rate
00	Divide 1
01	Divide 2
10	Divide 4
11	Divide 8

- **OSCNUM[1:0] : Define Oscillator frequency division in power sequence.**

PWRSEQ_OSCNUM[1:0]	Frame rate
00	Divide 1
01	Divide 2
10	Divide 4
11	Divide 8

- **PCLKNUM_IDLE[1:0] : Define PCLK frequency division in idle mode.**

PWRSEQ_OSCNUM[1:0]	Frame rate
00	Divide 1
01	Divide 2
10	Divide 4
11	Divide 8

- **PCLKNUM_NORM [1:0] : Define PCLK frequency division in norm mode.**

PWRSEQ_OSCNUM[1:0]	Frame rate
00	Divide 1
01	Divide 2
10	Divide 4
11	Divide 8

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.19. RGB_VIDEO_SET(C1A1h): RGB Video Mode Setting

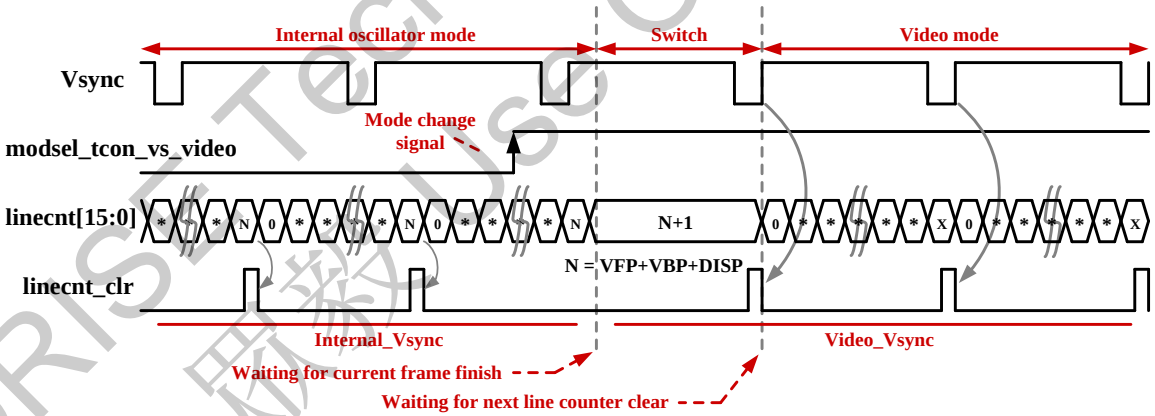
Address	C1h										
Address (SPI/I2C/MDDI)	C1A1h (0xA2nd parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	0	0	0	1	C1h
162nd Parameter	Write/Read		0	0	0	0	rgb_vs_video	rgb_hs_video	rgb_bp_video	rgb_clk_video	0Dh

Description

- This command is used for select VS/HS/DE/CLK source from internal or external when RGB video mode

Signal	Internal Setting	External Setting
VS	rgb_vs_video=0	rgb_vs_video=1
HS	rgb_vs_video=0 rgb_hs_video=0	rgb_vs_video=1 rgb_hs_video=1
DE	rgb_vs_video=0 rgb_hs_video=0 rgb_bp_video=0	rgb_vs_video=1 rgb_hs_video=1 rgb_bp_video=1
CLK	rgb_vs_video=0 rgb_hs_video=0 rgb_clk_video=0	rgb_vs_video=1 rgb_hs_video=1 rgb_clk_video=1

- When RGB video mode, IC internal signal "modsel_tcon_vs_video" will refer to register "rgb_vs_video". For IC default, will control by video_Vsync



- In RGB video mode, for IC VS/HS/DE/CLK control by external signal, please set rgb_vs_video =1, rgb_hs_video =1, rgb_bp_video =1, rgb_clk_video =1.

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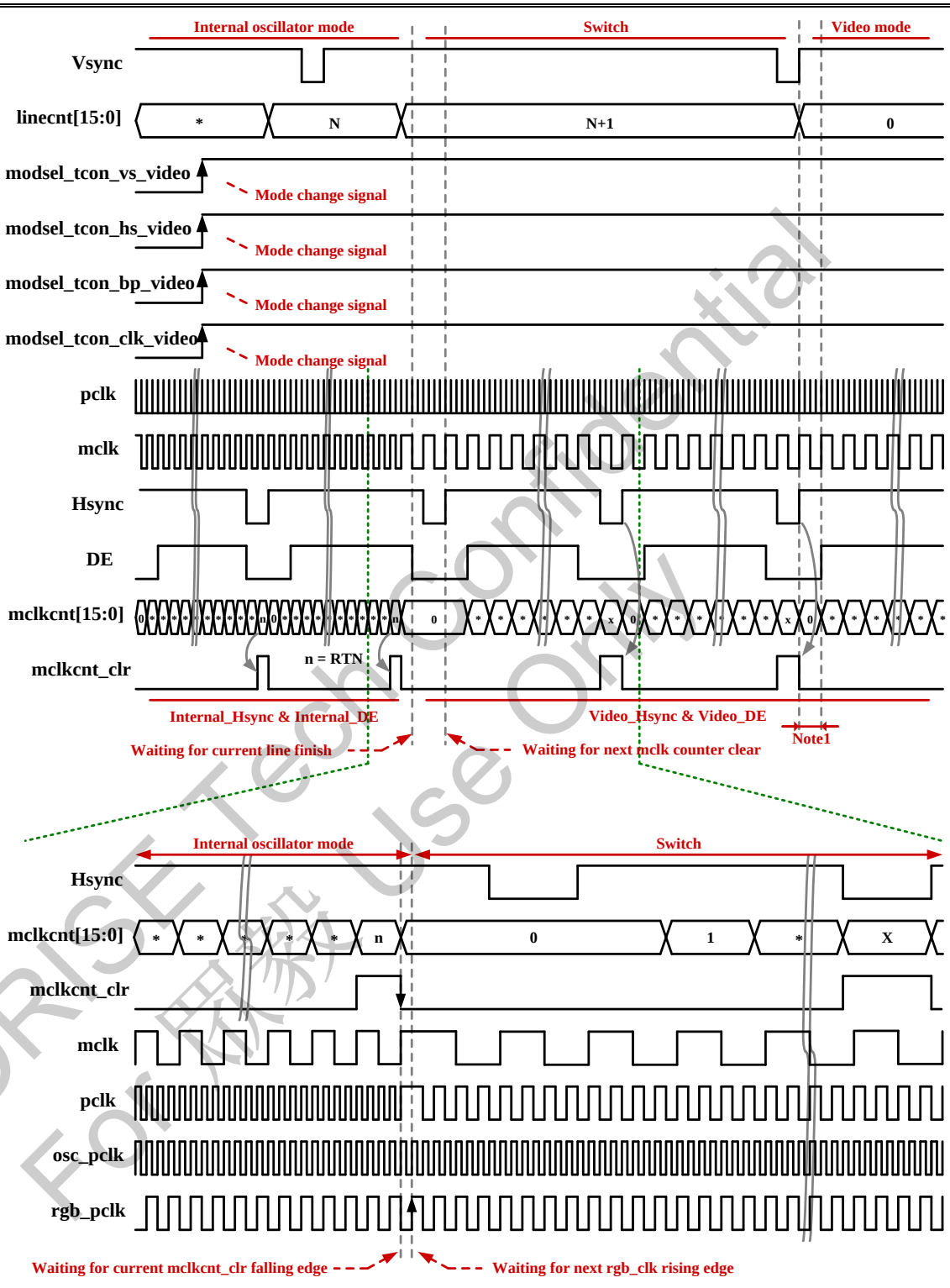

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.20. SD_PCH_CTRL(C480h): Source Driver Precharge Control

Address	C4h										
Address (SPI/I2C/MDDI)	C480h ~C481h (0x81st ~ 0x82nd parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	0	1	0	0	C4h
129th Parameter	Write/Read		0	0	SD_PT [1]	SD_PT [0]	0	0	0	0	00h
130th Parameter	Write/Read		1	0	0	0	0	sd_sap [2:0]			84h

Description

129rd Parameter	Value	Source output levels during porch and non-display area
SD_PT [1:0]	00	Minimum voltage difference
	01	Maximum voltage difference
	10	Hi-Z
	11	GND

130th Parameter	Value	Description
sd_sap [2:0]	0~7	Adjust bias current of source OP

IBIAS_SAP[2:0]	I (uA)
3'b000	0.6
3'b001	0.67
3'b010	0.75
3'b011	0.86
3'b100	1.0
3'b101	1.2
3'b110	1.5
3'b111	2.0

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.21. PWR_CTRL1(C580h): Power Control Setting 1

Address (MIPI)	C5h										
Address (SPI/I2C/MDDI)	C580h~ C583h(0x81st ~ 0x84th parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	0	1	0	1	C5h
129th Parameter	Write/Read		pump1_en_asdm	pump1_en_asdm_pwron	pump1_en_asdm2	pump4_en_asdm_hv	pump1_soft_dm [1:0]		pump1_det_frm [1:0]		08h
130th Parameter	Write/Read		0	pump1_max_dm[2:0]			0	pump1_min_dm[2:0]			00h
131st Parameter	Write/Read		pump1_ss_width [1:0]		pump1_clamp [1:0]		0	0	en_C24	en_C32	80h
132nd Parameter	Write/Read		0	goa_vgho_s [2:0]			0	0	0	0	00h

Description

- This command is used to adjust analog power behavior.
- Pump ratio value will been adjusted automatically when auto setting function is active. When auto setting function is off, pump ratio will be decided by manual setting.

129th Parameter	Value	Description
pump1_en_asdm	0	Disable VDDA Pump auto setting for LVD condition after Power on sequence
	1	Enable VDDA Pump auto setting for LVD condition after Power on sequence
pump1_en_asdm_pwron	0	Disable VDDA Pump auto setting for LVD condition in Power on sequence
	1	Enable VDDA Pump auto setting for LVD condition in Power on sequence
pump1_en_asdm2	0	Disable VDDA Pump auto setting for DLVD conditivon
	1	Enable VDDA Pump auto setting for DLVD condition
pump4_en_asdm_hv	0	Disable VGH Pmp4 auto setting
	1	Enable VGH Pmp4 auto setting
pump1_soft_dm [1:0]	0~3	VDDA PUMP power-on dm increase max. value
pump1_det_frm [1:0]	0~3	Pump Decrease DM Count Frame number

pump1_soft_dm [1]	pump1_soft_dm [0]	VDDA pump-ratio
0	0	1.0*VDD
0	1	1.5*VDD
1	0	2.0*VDD
1	1	3.0*VDD

pump1_det_frm [1]	pump1_det_frm [0]	Detect Counter
0	0	512 Frames
0	1	2048 Frames
1	0	8192 Frames
1	1	32768 Frames

130th Parameter	Value	Description
pump1_max_dm[2:0]	0~3	PUMP1 max DM after Power On Sequence pump1_max_dm[2] is used to enable this setting
pump1_min_dm[2:0]	0~3	PUMP1 min DM after Power On Sequence pump1_min_dm[2] is used to enable this setting

131st Parameter	Value	Max. AVDDP1 Pump Ratio for auto setting (Normal Display)
pump1_ss_width [1:0]	0~3	PUMP1 soft ware start pulse width

pump1_ss_width [1]	pump1_ss_width [0]	Soft Start Pulse width
0	0	25 Lines
0	1	27 Lines
1	0	29 Lines
1	1	BP+FP-2 Lines

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<table>
<tr><td rowspan="7"></td><td>pump1_clamp [1:0]</td><td>0~3</td><td>Setting the clamp level of VDDA
<table><tr><th>I_PUMP1_CLAMP[1]</th><th>I_PUMP1_CLAMP[0]</th><th>CLAMP voltage of VDDA</th></tr><tr><td>0</td><td>0</td><td>6.00</td></tr><tr><td>0</td><td>1</td><td>6.25</td></tr><tr><td>1</td><td>0</td><td>6.50</td></tr><tr><td>1</td><td>1</td><td>5.75</td></tr></table></td></tr>
<tr><td rowspan="2">en_C24</td><td>0</td><td>Disable Flying Cap23,Cap24</td></tr>
<tr><td>1</td><td>Enable Flying Cap23,Cap24</td></tr>
<tr><td rowspan="2">en_C32</td><td>0</td><td>Disable Flying Cap32</td></tr>
<tr><td>1</td><td>Enable Flying Cap32</td></tr>
<tr><td>goa_vgho_s [2:0]</td><td>0~7</td><td><table><tr><th colspan="2">GOA_EN_VGHO="1"</th></tr><tr><td>GOA_VGHO_S[2]</td><td>VGHO</td></tr><tr><td>0</td><td>VGH</td></tr><tr><td>1</td><td>VRGH</td></tr></table>
<table><tr><th colspan="2">GOA_EN_VGHO="0"</th></tr><tr><td>GOA_VGHO_S[1:0]</td><td>VGHO</td></tr><tr><td>2'b00</td><td>VGH</td></tr><tr><td>2'b01</td><td>VSS</td></tr><tr><td>2'b10</td><td>Hi-Z</td></tr><tr><td>2'b11</td><td>Hi-Z</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="3"><table><tr><th>Status</th><th>Default Value</th></tr><tr><td>OTP un-programmed</td><td>Set as default value</td></tr><tr><td>OTP Programmed</td><td>Set as OTP value</td></tr></table></td></tr>
</table>

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5.3.22. PWR_CTRL2(C590h): Power Control Setting 2 for Normal Mode

Address	C5h										
Address (SPI/I2C/MDDI)	C590h~ C596h (0x91st ~ 0x97th parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	0	1	0	1	C5h
145th Parameter	Write/Read		pump1_dm_n [1:0]		pump1_det_n [1:0]		0	pump1_dlvd_sel_n [2:0]			96h
146th Parameter	Write/Read		pump4_vghs_n [3:0]				pump5_vgls_n [3:0]				79h
147th Parameter	Write/Read		0	0	0	0	0	pump4_x6_n	pump5_x4_n	pump45_x6_n	00h
148th Parameter	Write/Read		hvreg_vrgh_s_n [3:0]				hvreg_vglreg_s_n [3:0]				33h
149th Parameter	Write/Read		0	pump1_clk_ratio_n [2:0]			0	pump2_clk_ratio_n [2:0]			33h
150th Parameter	Write/Read		0	pump3_clk_ratio_n [2:0]			0	pump4_clk_ratio_n [2:0]			33h
151th Parameter	Write/Read		0	analog_ibias_gp_n [2:0]			0	analog_ibias_ap_n [2:0]			43h

Description

- This command is used to adjust various pump settings for **Normal Mode**.

145th Parameter	Value	Description
pump1_dm_n [1:0]	0~3	PUMP1 DM in normal display region and DM auto setting disable in Normal Mode
pump1_det_n [1:0]	0~3	PUMP1 VDDA low-voltage detection in Normal Mode
pump1_dlvd_sel_n [2:0]	0~7	PUMP1 VDDA Dlow-voltage detection in Normal Mode

pump1_dm_n [1]	pump1_dm_n [0]	VDDA pump-ratio
0	0	1.0*VDD
0	1	1.5*VDD
1	0	2.0*VDD
1	1	3.0*VDD

pump1_det_n [1]	pump1_det_n [0]	LVD level of VDDA
0	0	GVDD+0.3V
0	1	GVDD+0.4V
1	0	GVDD+0.5V
1	1	GVDD+0.6V

pump1_dlvd_sel_n [2]	pump1_dlvd_sel_n [1]	pump1_dlvd_sel_n [0]	DLVD level of VDDA
0	0	0	GVDD+1.4V
0	0	1	GVDD+1.3V
0	1	0	GVDD+1.2V
0	1	1	GVDD+1.1V
1	0	0	GVDD+1.0V
1	0	1	GVDD+0.9V
1	1	0	GVDD+0.8V
1	1	1	GVDD+0.7V

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146th Parameter	Value	Description
pump4_vghs_n [3:0]	0~15	PUMP4 VGH voltage select in Normal Mode

pump4_vghs_n[3:0]	VGH Voltage	pump4_vghs_n[3:0]	VGH Voltage
4'b0000	11.5 V	4'b1000	15.5 V
4'b0001	12.0 V	4'b1001	16.0 V
4'b0010	12.5 V	4'b1010	16.5 V
4'b0011	13.0 V	4'b1011	17.0 V
4'b0100	13.5 V	4'b1100	17.5 V
4'b0101	14.0 V	4'b1101	18.0 V
4'b0110	14.5 V	4'b1110	18.5 V
4'b0111	15.0 V	4'b1111	19.0 V

pump5_vgls_n [3:0]	0~15	PUMP5 VGL voltage select in Normal Mode

pump5_vgls_n[3:0]	VGL Voltage	pump5_vgls_n[3:0]	VGL Voltage
4'b0000	-7.0 V	4'b1000	-11.5 V
4'b0001	-7.5 V	4'b1001	-12.0 V
4'b0010	-8.0 V	4'b1010	-12.5 V
4'b0011	-8.5 V	4'b1011	-13.0 V
4'b0100	-9.0 V	4'b1100	-14.0 V
4'b0101	-9.5 V	4'b1101	-14.5 V
4'b0110	-10.0 V	4'b1110	-15.0 V
4'b0111	-11.0 V	4'b1111	-15.5 V

147th Parameter	Value	Description
pump4_x6_n	0	VGH = 8 X VDD, Only Valid when PUMP4_EN_ASDM_HV = "0"
	1	VGH = 6 X VDD, Only Valid when PUMP4_EN_ASDM_HV = "0"
pump5_x4_n	0	VGL = -6 X VDD, Only Valid when PUMP4_EN_ASDM_HV = "0"
	1	VGL = -4 X VDD, Only Valid when PUMP4_EN_ASDM_HV = "0"
pump45_x6_n	0	Set VGH by pump4_x6_n & set VGL by pump5_x4_n, Only Valid when PUMP4_EN_ASDM_HV = "0"
	1	Set VGH = 6 X VDD & VGL = -6 X VDD , Only Valid when PUMP4_EN_ASDM_HV = "0"

148th Parameter	Value	Description
hvreg_vrgh_s_n [3:0]	0~7	HV-regulator VRGH voltage select in Normal Mode

HVREG_VRGH_S[3:0]	VRGH Voltage	HVREG_VRGH_S[3:0]	VRGH Voltage
4'b0000	8.5 V	4'b1000	12.5 V
4'b0001	9 V	4'b1001	13 V
4'b0010	9.5 V	4'b1010	13.5 V
4'b0011	10 V	4'b1011	14 V
4'b0100	10.5 V	4'b1100	14.5 V
4'b0101	11 V	4'b1101	15 V
4'b0110	11.5 V	4'b1110	15.5 V
4'b0111	12 V	4'b1111	16 V

hvreg_vglreg_s_n [3:0]	0~7	HV-regulator VGL-REG voltage select in Normal Mode

HVREG_VGLREG_S[3:0]	VGL_REG Voltage	HVREG_VGLREG_S[3:0]	VGL_REG Voltage
4'b0000	-7.0 V	4'b1000	-11.5 V
4'b0001	-7.5 V	4'b1001	-12.0 V
4'b0010	-8.0 V	4'b1010	-12.5 V
4'b0011	-8.5 V	4'b1011	-13.0 V
4'b0100	-9.0 V	4'b1100	-14.0 V
4'b0101	-9.5 V	4'b1101	-14.5 V
4'b0110	-10.0 V	4'b1110	-15.0 V
4'b0111	-11.0 V	4'b1111	-15.5 V

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149th Parameter	Value	Description
pump1_clk_ratio_n [2:0]	0~7	PUMP1 set pump clock ratio pump1_clk_ratio_n [2:0] / VDDA Pump Clock Frequency 3'b000 / 8 Lines 3'b001 / 4 Lines 3'b010 / 2 Lines 3'b011 / 1 Line 3'b100 / 1 / 2 Line 3'b101 / 1 / 4 Line 3'b110 / 1 / 8 Line 3'b111 / 1 / 16 Line
pump2_clk_ratio_n [2:0]	0~7	PUMP2 set pump clock ratio pump2_clk_ratio_n [2:0] / NVDDA Pump Clock Frequency 3'b000 / 8 Lines 3'b001 / 4 Lines 3'b010 / 2 Lines 3'b011 / 1 Line 3'b100 / 1 / 2 Line 3'b101 / 1 / 4 Line 3'b110 / 1 / 8 Line 3'b111 / 1 / 16 Line

150th Parameter	Value	Description
pump3_clk_ratio_n [2:0]	0~7	PUMP3 set pump clock ratio pump3_clk_ratio_n [2:0] / VCL Pump Clock Frequency 3'b000 / 8 Lines 3'b001 / 4 Lines 3'b010 / 2 Lines 3'b011 / 1 Line 3'b100 / 1 / 2 Line 3'b101 / 1 / 4 Line 3'b110 / 1 / 8 Line 3'b111 / 1 / 16 Line
pump4_clk_ratio_n [2:0]	0~7	PUMP4 set pump clock ratio pump4_clk_ratio_n [2:0] / VGH/VGL Pump Clock Frequency 3'b000 / 8 Lines 3'b001 / 4 Lines 3'b010 / 2 Lines 3'b011 / 1 Line 3'b100 / 1 / 2 Line 3'b101 / 1 / 4 Line 3'b110 / 1 / 8 Line 3'b111 / 1 / 16 Line

151th Parameter	Value	Bias Current Selection
analog_ibias_gp_n [2:0]	000	2.0 uA
	001	2.5 uA
	010	3.0 uA
	011	3.5 uA
	100	4.0 uA
	101	4.5 uA
	110	5.0 uA
	111	5.5 uA

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	<table><tr><th>151th Parameter</th><th>Value</th><th>Trim Bias Current</th></tr><tr><td rowspan="8">analog_ibias_ap_n [2:0]</td><td>000</td><td>60%</td></tr><tr><td>001</td><td>60%</td></tr><tr><td>010</td><td>70%</td></tr><tr><td>011</td><td>85%</td></tr><tr><td>100</td><td>100%</td></tr><tr><td>101</td><td>120%</td></tr><tr><td>110</td><td>140%</td></tr><tr><td>111</td><td>160%</td></tr></table>
Default	<table><tr><th>Status</th><th>Default Value</th></tr><tr><td>OTP un-programmed</td><td>Set as default value</td></tr><tr><td>OTP Programmed</td><td>Set as OTP value</td></tr></table>

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5.3.23. PWR_CTRL3(C5A0h): Power Control Setting 3 for Idle Mode

Address	C5h										
Address (SPI/I2C/MDDI)	C5A0h~ C5A6h (0xA1st ~ 0xA7th parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	0	1	0	1	C5h
161th Parameter	Write/Read		pump1_dm_i [1:0]		pump1_det_i [1:0]		0	pump1_dlvd_sel_i [2:0]			96h
162th Parameter	Write/Read		pump4_vghs_i [3:0]				pump5_vgls_i [3:0]				79h
163th Parameter	Write/Read		0	0	0	0	0	pump4_x6_i	pump5_x4_i	pump45_x6_i	00h
164th Parameter	Write/Read		hvreg_vrgh_s_i [3:0]				hvreg_vglreg_s_i [3:0]				33h
165th Parameter	Write/Read		0	pump1_clk_ratio_i [2:0]			0	pump2_clk_ratio_i [2:0]			33h
166th Parameter	Write/Read		0	pump3_clk_ratio_i [2:0]			0	pump4_clk_ratio_i [2:0]			33h
167th Parameter	Write/Read		0	analog_ibias_gp_i [2:0]			0	analog_ibias_ap_i [2:0]			43h

Description

- This command is used to adjust various pump settings for **Idle Mode**.

161th Parameter	Value	Description
pump1_dm_i [1:0]	0~3	PUMP1 DM in normal display region and DM auto setting disable in Normal Mode

pump1_dm_n [1]	pump1_dm_n [0]	VDDA pump-ratio
0	0	1.0*VDD
0	1	1.5*VDD
1	0	2.0*VDD
1	1	3.0*VDD

pump1_det_i [1:0] — 0~3 — PUMP1 VDDA low-voltage detection in Normal Mode

pump1_det_n [1]	pump1_det_n [0]	LVD level of VDDA
0	0	GVDD+0.3V
0	1	GVDD+0.4V
1	0	GVDD+0.5V
1	1	GVDD+0.6V

pump1_dlvd_sel_i [2:0] — 0~7 — PUMP1 VDDA Dlow-voltage detection in Normal Mode

pump1_dlvd_sel_n [2]	pump1_dlvd_sel_n [1]	pump1_dlvd_sel_n [0]	DLVD level of VDDA
0	0	0	GVDD+1.4V
0	0	1	GVDD+1.3V
0	1	0	GVDD+1.2V
0	1	1	GVDD+1.1V
1	0	0	GVDD+1.0V
1	0	1	GVDD+0.9V
1	1	0	GVDD+0.8V
1	1	1	GVDD+0.7V

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162th Parameter	Value	Description
pump4_vghs_i [3:0]	0~15	PUMP4 VGH voltage select in Idle Mode

pump4_vghs_i[3:0]	VGH Voltage	pump4_vghs_i[3:0]	VGH Voltage
4'b0000	11.5 V	4'b1000	15.5 V
4'b0001	12.0 V	4'b1001	16.0 V
4'b0010	12.5 V	4'b1010	16.5 V
4'b0011	13.0 V	4'b1011	17.0 V
4'b0100	13.5 V	4'b1100	17.5 V
4'b0101	14.0 V	4'b1101	18.0 V
4'b0110	14.5 V	4'b1110	18.5 V
4'b0111	15.0 V	4'b1111	19.0 V

pump5_vgls_i [3:0]	0~15	PUMP5 VGL voltage select in Idle Mode

pump5_vgls_i[3:0]	VGL Voltage	pump5_vgls_i[3:0]	VGL Voltage
4'b0000	-7.0 V	4'b1000	-11.5 V
4'b0001	-7.5 V	4'b1001	-12.0 V
4'b0010	-8.0 V	4'b1010	-12.5 V
4'b0011	-8.5 V	4'b1011	-13.0 V
4'b0100	-9.0 V	4'b1100	-14.0 V
4'b0101	-9.5 V	4'b1101	-14.5 V
4'b0110	-10.0 V	4'b1110	-15.0 V
4'b0111	-11.0 V	4'b1111	-15.5 V

163th Parameter	Value	Description
pump4_x6_i	0	VGH = 8 X VDD, Only Valid when PUMP4_EN_ASDM_HV = "0" & "Idle Mode On"
	1	VGH = 6 X VDD, Only Valid when PUMP4_EN_ASDM_HV = "0" & "Idle Mode On"
pump5_x4_i	0	VGL = -6 X VDD, Only Valid when PUMP4_EN_ASDM_HV = "0" & "Idle Mode On"
	1	VGL = -4 X VDD, Only Valid when PUMP4_EN_ASDM_HV = "0" & "Idle Mode On"
pump45_x6_i	0	Set VGH by pump4_x6_n & set VGL by pump5_x4_n, Only Valid when PUMP4_EN_ASDM_HV = "0" & "Idle Mode On"
	1	Set VGH = 6 X VDD & VGL = -6 X VDD , Only Valid when PUMP4_EN_ASDM_HV = "0" & "Idle Mode On"

164th Parameter	Value	Description
hvreg_vrgh_s_i [3:0]	0~7	HV-regulator VRGH voltage select in Idle Mode

HVREG_VRGH_S[3:0]	VRGH Voltage	HVREG_VRGH_S[3:0]	VRGH Voltage
4'b0000	8.5 V	4'b1000	12.5 V
4'b0001	9 V	4'b1001	13 V
4'b0010	9.5 V	4'b1010	13.5 V
4'b0011	10 V	4'b1011	14 V
4'b0100	10.5 V	4'b1100	14.5 V
4'b0101	11 V	4'b1101	15 V
4'b0110	11.5 V	4'b1110	15.5 V
4'b0111	12 V	4'b1111	16 V

hvreg_vglreg_s_i [3:0]	0~7	HV-regulator VGL-REG voltage select in Idle Mode

HVREG_VGLREG_S[3:0]	VGL_REG Voltage	HVREG_VGLREG_S[3:0]	VGL_REG Voltage
4'b0000	-7.0 V	4'b1000	-11.5 V
4'b0001	-7.5 V	4'b1001	-12.0 V
4'b0010	-8.0 V	4'b1010	-12.5 V
4'b0011	-8.5 V	4'b1011	-13.0 V
4'b0100	-9.0 V	4'b1100	-14.0 V
4'b0101	-9.5 V	4'b1101	-14.5 V
4'b0110	-10.0 V	4'b1110	-15.0 V
4'b0111	-11.0 V	4'b1111	-15.5 V

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165th Parameter	Value	Description
pump1_clk_ratio_i [2:0]	0~7	PUMP1 set pump clock ratio pump1_clk_ratio_i [2:0] / VDDA Pump Clock Frequency 3'b000 / 8 Lines 3'b001 / 4 Lines 3'b010 / 2 Lines 3'b011 / 1 Line 3'b100 / 1 / 2 Line 3'b101 / 1 / 4 Line 3'b110 / 1 / 8 Line 3'b111 / 1 / 16 Line
pump2_clk_ratio_i [2:0]	0~7	PUMP2 set pump clock ratio pump2_clk_ratio_i [2:0] / NVDDA Pump Clock Frequency 3'b000 / 8 Lines 3'b001 / 4 Lines 3'b010 / 2 Lines 3'b011 / 1 Line 3'b100 / 1 / 2 Line 3'b101 / 1 / 4 Line 3'b110 / 1 / 8 Line 3'b111 / 1 / 16 Line

166th Parameter	Value	Description
pump3_clk_ratio_i [2:0]	0~7	PUMP3 set pump clock ratio pump3_clk_ratio_i [2:0] / VCL Pump Clock Frequency 3'b000 / 8 Lines 3'b001 / 4 Lines 3'b010 / 2 Lines 3'b011 / 1 Line 3'b100 / 1 / 2 Line 3'b101 / 1 / 4 Line 3'b110 / 1 / 8 Line 3'b111 / 1 / 16 Line
pump4_clk_ratio_i [2:0]	0~7	PUMP4 set pump clock ratio pump4_clk_ratio_i [2:0] / VGH/VGL Pump Clock Frequency 3'b000 / 8 Lines 3'b001 / 4 Lines 3'b010 / 2 Lines 3'b011 / 1 Line 3'b100 / 1 / 2 Line 3'b101 / 1 / 4 Line 3'b110 / 1 / 8 Line 3'b111 / 1 / 16 Line

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167th Parameter	Value	Bias Current Selection
analog_ibias_gp_i [2:0]	000	2.0 uA
	001	2.5 uA
	010	3.0 uA
	011	3.5 uA
	100	4.0 uA
	101	4.5 uA
	110	5.0 uA
	111	5.5 uA

167th Parameter	Value	Trim Bias Current
analog_ibias_ap_i [2:0]	000	60%
	001	60%
	010	70%
	011	85%
	100	100%
	101	120%
	110	140%
	111	160%

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.24. PWR_CTRL4(C5B0h): Power Control Setting 4 for DC Voltage Settings

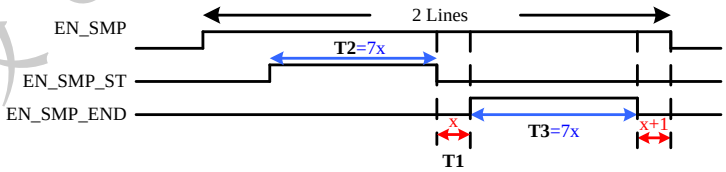
Address	C5h										
Address (SPI/I2C/MDDI)	C5B0h ~ C5B1h (0xB1st ~ 0xB2th parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	0	1	0	1	C5h
177th Parameter	Write/Read		pwr_te_sel	pwr_led_sel	smpwid [4:0]						04h
178th Parameter	Write/Read		vdd18v_sel [1:0]		lvdsvdd_sel [1:0]		diopwr_sel	0	gvdd_vcom_gnd	gvdd_en_test	A8h

Description

- pwr_te_sel : select TE output voltage level
- pwr_led_sel : select LEDON/LEDPWM output voltage level

DSTB_SEL	VDDIO	VSEL	DIOPWR	Output voltage level			
				TE		LEDON, LEDPWM	
				pwr_te_sel = 0	pwr_te_sel = 1	pwr_led_sel=0	pwr_led_sel=1
0	1.65~3.3v or 1.1~1.3v	Low	1.2v	VOH=VDDIO VOL=VSS		VOH=VDDIO VOL=VSS	VOH=VDD VOL=VSS
		High	1.8v	VOH=VDDIO VOL=VSS		VOH=VDDIO VOL=VSS	VOH=VDD VOL=VSS
1	1.65~3.3v	Low	1.2v	VOH=DIOPWR VOL=VSS		VOH=DIOPWR VOL=VSS	
		High	1.8v	VOH=VDDIO VOL=VSS	VOH=DIOPWR	VOH=VDDIO VOL=VSS	VOH=VDD VOL=VSS
1	1.1~1.3v	Low	1.2v	VOH=DIOPWR VOL=VSS		VOH=DIOPWR VOL=VSS	
		High	1.8v	VOH=DIOPWR VOL=VSS		VOH=DIOPWR VOL=VSS	

177th Parameter	Value	Description
smpwid [4:0]	0~15	VCOM sample hold pulse width x



178th Parameter	Value	Voltage Selection for VDD_18V
vdd18v_sel [1:0]	00	1.70V
	01	1.65V
	10	1.60V
	11	1.55V

178th Parameter	Value	Voltage Selection for LVDSVDD
lvdsvdd_sel [1:0]	00	1.70V
	01	1.65V
	10	1.60V
	11	1.55V

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178th Parameter	Value	Description
diopwr_sel	0	1.2V
	1	1.8V
gvdd_vcom_gnd	0	VCOMDC voltage be set by vcom_vmdc[7:0]
	1	VCOMDC voltage set to GND
gvdd_en_test	0	Disable VCOM test mode
	1	Enable VCOM test mode

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.25. PWM_PARA1 (C680H) PWM Parameter 1

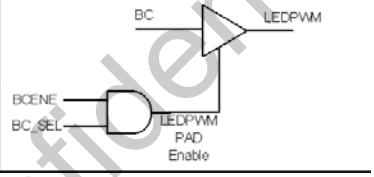
Address	C6h										
Address (SPI/I2C/MDDI)	C680h (0x81st parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	0	1	1	0	C6h
129th Parameter	Write/Read		1	BCENE	CABC_EN	1	0	BC_SEL	0	0	F4h

Description

- This command is used to set the internal function block of LPWM.

-BCENE : This bit combine with BC_SEL register to control LEDPWM PIN output.

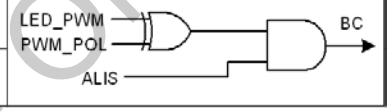
BCENE[D6]	Control LEDPWM
0	Diable, LEDPWM=0.
1	Enable, if BC_SEL=1, LEDPWM output BC pulse



- **CABC_EN :** This bit is used to control CABC related Command enable (include: $51,$53, $55, $5E)

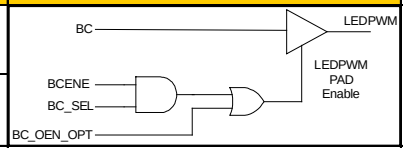
CABC_EN5[D5]	CABC related Command
0	Disable
1	Enable(Default)

ALIS[D4]	KBBC / LEDPWM Function
0	Diable, KBBC / LEDPWM Function disable
1	Enable, KBBC / LEDPWM Function enable (Default).



- BC_SEL : This bit combine with BCENE and BC_OEN_OPT register to control LEDPWM PIN output.

BC_SEL	Control LEDPWM
0	Disable, LEDPWM=0
1	Enable, if BC_SEL=1, LEDPWM output BC pulse



Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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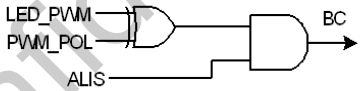
5.3.26. PWM_PARA2 (C6B0H) PWM Parameter 2

Address	C6h										
Address (SPI/I2C/MDDI)	C6B0h (0xB1st parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	0	1	1	0	C6h
177th Parameter	Write/Read		PWM_POL	0	0	0	BC_MOD[1]	BC_MOD[0]	1	1	03h

Description	- **BC_MOD[1:0] :** **00 :** BC pulse will not be clear by Vsync signal. **01 :** BC pulse will be clear by Vsync pulse sigmal. - **PWM_POL :** Polarity of LEDPWM output. PWM_POL[D7] / Polarity of LEDPWM output. 0 / Non-Inversion, LEDPWM=0. 1 / Inversion. 
Default	Status: OTP un-programmed — Default Value: Set as default value Status: OTP Programmed — Default Value: Set as OTP value

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5.3.27. PWM_PARA3 (C6B1H) PWM Parameter 3

Address	C6h										
Address (SPI/I2C/MDDI)	C6B1h (0xB2nd parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	0	1	1	0	C6h
178th Parameter	Write/Read		DBF[7]	DBF[6]	DBF[5]	DBF[4]	DBF[3]	DBF[2]	DBF[1]	DBF[0]	10h

Description

- This command is used to adjust PWM Freq.
The PWM Freq can be set by DBF and PWM_FREQ_SEL as following table.

DBF	PWM_FREQ_SEL[1:0] (KHz)				DBF	PWM_FREQ_SEL[1:0] (KHz)				DBF	PWM_FREQ_SEL[1:0] (KHz)			
	00	01	10	11		00	01	10	11		00	01	10	11
0	68.359	136.718	34.179	17.089	86	0.785	1.571	0.392	0.196	172	0.395	0.79	0.197	0.098
1	34.179	68.359	17.089	8.544	87	0.776	1.553	0.388	0.194	173	0.392	0.785	0.196	0.098
2	22.786	45.572	11.393	5.696	88	0.768	1.536	0.384	0.192	174	0.39	0.781	0.195	0.097
3	17.089	34.179	8.544	4.272	89	0.759	1.519	0.379	0.189	175	0.388	0.776	0.194	0.097
4	13.671	27.343	6.835	3.417	90	0.751	1.502	0.375	0.187	176	0.386	0.772	0.193	0.096
5	11.393	22.786	5.696	2.848	91	0.743	1.486	0.371	0.185	177	0.384	0.768	0.192	0.096
6	9.765	19.531	4.882	2.441	92	0.735	1.47	0.367	0.183	178	0.381	0.763	0.19	0.095
7	8.544	17.089	4.272	2.136	93	0.727	1.454	0.363	0.181	179	0.379	0.759	0.189	0.094
8	7.595	15.19	3.797	1.898	94	0.719	1.439	0.359	0.179	180	0.377	0.755	0.188	0.094
9	6.835	13.671	3.417	1.708	95	0.712	1.424	0.356	0.178	181	0.375	0.751	0.187	0.093
10	6.214	12.428	3.107	1.553	96	0.704	1.409	0.352	0.176	182	0.373	0.747	0.186	0.093
11	5.696	11.393	2.848	1.424	97	0.697	1.395	0.348	0.174	183	0.371	0.743	0.185	0.092
12	5.258	10.516	2.629	1.314	98	0.69	1.38	0.345	0.172	184	0.369	0.739	0.184	0.092
13	4.882	9.765	2.441	1.22	99	0.683	1.367	0.341	0.17	185	0.367	0.735	0.183	0.091
14	4.557	9.114	2.278	1.139	100	0.676	1.353	0.338	0.169	186	0.365	0.731	0.182	0.091
15	4.272	8.544	2.136	1.068	101	0.67	1.34	0.335	0.167	187	0.363	0.727	0.181	0.09
16	4.021	8.042	2.01	1.005	102	0.663	1.327	0.331	0.165	188	0.361	0.723	0.18	0.09
17	3.797	7.595	1.898	0.949	103	0.657	1.314	0.328	0.164	189	0.359	0.719	0.179	0.089
18	3.597	7.195	1.798	0.899	104	0.651	1.302	0.325	0.162	190	0.357	0.715	0.178	0.089
19	3.417	6.835	1.708	0.854	105	0.644	1.289	0.322	0.161	191	0.356	0.712	0.178	0.089
20	3.255	6.51	1.627	0.813	106	0.638	1.277	0.319	0.159	192	0.354	0.708	0.177	0.088
21	3.107	6.214	1.553	0.776	107	0.632	1.265	0.316	0.158	193	0.352	0.704	0.176	0.088
22	2.972	5.944	1.486	0.743	108	0.627	1.254	0.313	0.156	194	0.35	0.701	0.175	0.087
23	2.848	5.696	1.424	0.712	109	0.621	1.242	0.31	0.155	195	0.348	0.697	0.174	0.087
24	2.734	5.468	1.367	0.683	110	0.615	1.231	0.307	0.153	196	0.347	0.694	0.173	0.086
25	2.629	5.258	1.314	0.657	111	0.61	1.22	0.305	0.152	197	0.345	0.69	0.172	0.086
26	2.531	5.063	1.265	0.632	112	0.604	1.209	0.302	0.151	198	0.343	0.687	0.171	0.085
27	2.441	4.882	1.22	0.61	113	0.599	1.199	0.299	0.149	199	0.341	0.683	0.17	0.085
28	2.357	4.714	1.178	0.589	114	0.594	1.188	0.297	0.148	200	0.34	0.68	0.17	0.085
29	2.278	4.557	1.139	0.569	115	0.589	1.178	0.294	0.147	201	0.338	0.676	0.169	0.084
30	2.205	4.41	1.102	0.551	116	0.584	1.168	0.292	0.146	202	0.336	0.673	0.168	0.084
31	2.136	4.272	1.068	0.534	117	0.579	1.158	0.289	0.144	203	0.335	0.67	0.167	0.083
32	2.071	4.142	1.035	0.517	118	0.574	1.148	0.287	0.143	204	0.333	0.666	0.166	0.083
33	2.01	4.021	1.005	0.502	119	0.569	1.139	0.284	0.142	205	0.331	0.663	0.165	0.082
34	1.953	3.906	0.976	0.488	120	0.564	1.129	0.282	0.141	206	0.33	0.66	0.165	0.082
35	1.898	3.797	0.949	0.474	121	0.56	1.12	0.28	0.14	207	0.328	0.657	0.164	0.082
36	1.847	3.695	0.923	0.461	122	0.555	1.111	0.277	0.138	208	0.327	0.654	0.163	0.081
37	1.798	3.597	0.899	0.449	123	0.551	1.102	0.275	0.137	209	0.325	0.651	0.162	0.081
38	1.752	3.505	0.876	0.438	124	0.546	1.093	0.273	0.136	210	0.323	0.647	0.161	0.08
39	1.708	3.417	0.854	0.427	125	0.542	1.085	0.271	0.135	211	0.322	0.644	0.161	0.08
40	1.667	3.334	0.833	0.416	126	0.538	1.076	0.269	0.134	212	0.32	0.641	0.16	0.08
41	1.627	3.255	0.813	0.406	127	0.534	1.068	0.267	0.133	213	0.319	0.638	0.159	0.079
42	1.589	3.179	0.794	0.397	128	0.529	1.059	0.264	0.132	214	0.317	0.635	0.158	0.079
43	1.553	3.107	0.776	0.388	129	0.525	1.051	0.262	0.131	215	0.316	0.632	0.158	0.079
44	1.519	3.038	0.759	0.379	130	0.521	1.043	0.26	0.13	216	0.315	0.63	0.157	0.078
45	1.486	2.972	0.743	0.371	131	0.517	1.035	0.258	0.129	217	0.313	0.627	0.156	0.078
46	1.454	2.908	0.727	0.363	132	0.513	1.027	0.256	0.128	218	0.312	0.624	0.156	0.078
47	1.424	2.848	0.712	0.356	133	0.51	1.02	0.255	0.127	219	0.31	0.621	0.155	0.077
48	1.395	2.79	0.697	0.348	134	0.506	1.012	0.253	0.126	220	0.309	0.618	0.154	0.077
49	1.367	2.734	0.683	0.341	135	0.502	1.005	0.251	0.125	221	0.307	0.615	0.153	0.076
50	1.34	2.68	0.67	0.335	136	0.498	0.997	0.249	0.124	222	0.306	0.613	0.153	0.076
51	1.314	2.629	0.657	0.328	137	0.495	0.99	0.247	0.123	223	0.305	0.61	0.152	0.076
52	1.289	2.579	0.644	0.322	138	0.491	0.983	0.245	0.122	224	0.303	0.607	0.151	0.075
53	1.265	2.531	0.632	0.316	139	0.488	0.976	0.244	0.122	225	0.302	0.604	0.151	0.075
54	1.242	2.485	0.621	0.31	140	0.484	0.969	0.242	0.121	226	0.301	0.602	0.15	0.075
55	1.22	2.441	0.61	0.305	141	0.481	0.962	0.24	0.12	227	0.299	0.599	0.149	0.074
56	1.199	2.398	0.599	0.299	142	0.478	0.956	0.239	0.119	228	0.298	0.597	0.149	0.074
57	1.178	2.357	0.589	0.294	143	0.474	0.949	0.237	0.118	229	0.297	0.594	0.148	0.074

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58	1.158	2.317	0.579	0.289	144	0.471	0.942	0.235	0.117	230	0.295	0.591	0.147	0.073
59	1.139	2.278	0.569	0.284	145	0.468	0.936	0.234	0.117	231	0.294	0.589	0.147	0.073
60	1.12	2.241	0.56	0.28	146	0.465	0.93	0.232	0.116	232	0.293	0.586	0.146	0.073
61	1.102	2.205	0.551	0.275	147	0.461	0.923	0.23	0.115	233	0.292	0.584	0.146	0.073
62	1.085	2.17	0.542	0.271	148	0.458	0.917	0.229	0.114	234	0.29	0.581	0.145	0.072
63	1.068	2.136	0.534	0.267	149	0.455	0.911	0.227	0.113	235	0.289	0.579	0.144	0.072
64	1.051	2.103	0.525	0.262	150	0.452	0.905	0.226	0.113	236	0.288	0.576	0.144	0.072
65	1.035	2.071	0.517	0.258	151	0.449	0.899	0.224	0.112	237	0.287	0.574	0.143	0.071
66	1.02	2.04	0.51	0.255	152	0.446	0.893	0.223	0.111	238	0.286	0.572	0.143	0.071
67	1.005	2.01	0.502	0.251	153	0.443	0.887	0.221	0.11	239	0.284	0.569	0.142	0.071
68	0.99	1.981	0.495	0.247	154	0.441	0.882	0.22	0.11	240	0.283	0.567	0.141	0.07
69	0.976	1.953	0.488	0.244	155	0.438	0.876	0.219	0.109	241	0.282	0.564	0.141	0.07
70	0.962	1.925	0.481	0.24	156	0.435	0.87	0.217	0.108	242	0.281	0.562	0.14	0.07
71	0.949	1.898	0.474	0.237	157	0.432	0.865	0.216	0.108	243	0.28	0.56	0.14	0.07
72	0.936	1.872	0.468	0.234	158	0.429	0.859	0.214	0.107	244	0.279	0.558	0.139	0.069
73	0.923	1.847	0.461	0.23	159	0.427	0.854	0.213	0.106	245	0.277	0.555	0.138	0.069
74	0.911	1.822	0.455	0.227	160	0.424	0.849	0.212	0.106	246	0.276	0.553	0.138	0.069
75	0.899	1.798	0.449	0.224	161	0.421	0.843	0.21	0.105	247	0.275	0.551	0.137	0.068
76	0.887	1.775	0.443	0.221	162	0.419	0.838	0.209	0.104	248	0.274	0.549	0.137	0.068
77	0.876	1.752	0.438	0.219	163	0.416	0.833	0.208	0.104	249	0.273	0.546	0.136	0.068
78	0.865	1.73	0.432	0.216	164	0.414	0.828	0.207	0.103	250	0.272	0.544	0.136	0.068
79	0.854	1.708	0.427	0.213	165	0.411	0.823	0.205	0.102	251	0.271	0.542	0.135	0.067
80	0.843	1.687	0.421	0.21	166	0.409	0.818	0.204	0.102	252	0.27	0.54	0.135	0.067
81	0.833	1.667	0.416	0.208	167	0.406	0.813	0.203	0.101	253	0.269	0.538	0.134	0.067
82	0.823	1.647	0.411	0.205	168	0.404	0.808	0.202	0.101	254	0.268	0.536	0.134	0.067
83	0.813	1.627	0.406	0.203	169	0.402	0.804	0.201	0.1	255	0.267	0.534	0.133	0.066
84	0.804	1.608	0.402	0.201	170	0.399	0.799	0.199	0.099					
85	0.794	1.589	0.397	0.198	171	0.397	0.794	0.198	0.099					

Unit: KHz

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.28. PWM_PARA4 (C6B3H) PWM Parameter 4

Address	C6h										
Address (SPI/I2C/MDDI)	C6B3h (0xB4th parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	0	1	1	0	C6h
180th Parameter	Write/Read		DFBC	LEDON_EN	LEDON_POL	LPWM_DIM_FRM[4]	LPWM_DIM_FRM[3]	LPWM_DIM_FRM[2]	LPWM_DIM_FRM[1]	LPWM_DIM_FRM[0]	5Fh

Description

- This command is used to set LEDPWM setting.

- **DFBC :**Default BC status before Power-ON.

DFBC[D7]	Default BC status before Power-ON.
0	LEDPWM='low'
1	LEDPWM='High

Note. It also XOR with "LPWM Parameter 9" PWM_POL.

- **LEDON_EN** : Enable LEDON PAD for external LED Driver

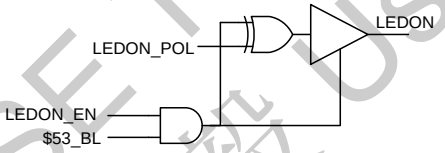
LEDON_EN[D6]	LEDON PAD for external LED Driver
0	Disable
1	Enable(Default)

Note. This function only active when $53_BL=1.

- **LEDON_POL**: Polarity of LEDON Control Signal

LEDON_POL[D5]	Polarity of LEDON Control Signal
0	Noraml(Default).
1	Inversion.

Note. This function only active when $53_BL=1 and LEDON_EN='1'.



- **LPWM_DIM_FRM[4:0]** : LPWM Dimming frame, Default is 32 Frame.

LPWM_DIM_FRM[4:0]	Frame
00h	1
01h	2
…	…
1Eh	31
1Fh	32

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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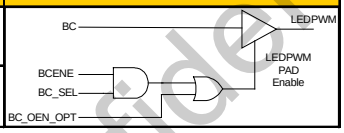
5.3.29. PWM_PARA5 (C6B4H) PWM Parameter 5

Address	C6h										
Address (SPI/I2C/MDDI)	C6B4h (0xB5th parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	0	1	1	0	C6h
181th Parameter	Write/Read		0	0	0	BC_OEN_OPT	0	PWM_FREQ_SEL[1]	PWM_FREQ_SEL[0]	CABC_DUTY_FORCE	12h

Description

- This command is used to set PWM Frequency setting.
- **BC_OEN_OPT :** If BC_OEN_OPT=1, the LCDPWM pad always output.

BC_SEL	Control LEDPWM
0	Disable, LEDPWM=0
1	Enable, if BC_SEL=1, LEDPWM output BC pulse



- **PWM_FREQ_SEL[1:0]:** Please refer “LPWM Parameter 10”
- **CABC_DUTY_FORCE:** Selector for giving a specific value to CABC Block. Please refer “PWM Control Architecture”

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.30. PWM_PARA6 (C6B5H) PWM Parameter 6

Address	**C6h**										
Address (SPI/I2C/MDDI)	**C6B5h (0xB6th parameter)**										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	0	1	1	0	C6h
182th Parameter	Write/Read		CABC_DUTY_SET[7]	CABC_DUTY_SET[6]	CABC_DUTY_SET[5]	CABC_DUTY_SET[4]	CABC_DUTY_SET[3]	CABC_DUTY_SET[2]	CABC_DUTY_SET[1]	CABC_DUTY_SET[0]	00h

Description	- This command is used to set specific CABC value. - **CABC_DUTY_SET[7:0] :** Giving Specific CABC Value for debug. Note: This function only active when “CABC_DUTY_FORCE” = ‘1’.
Default	Status: OTP un-programmed → Default Value: Set as default value Status: OTP Programmed → Default Value: Set as OTP value

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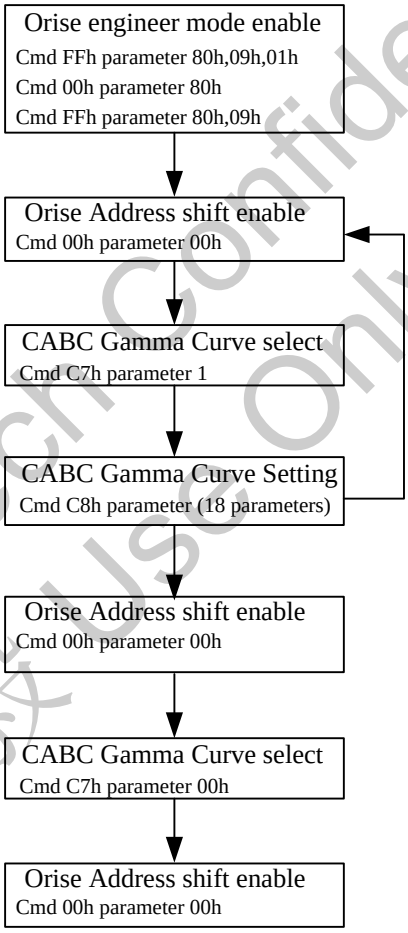
5.3.31. CABCSET1 (C700h): CABC Setting

Address	C7h										
Address (SPI/I2C/MDDI)	C700h (0x01st parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	0	1	1	1	C7h
Parameter 1	Write		0	0	0	CABC_SEL_ENA	CABC_SEL[3:0]				0Fh

Description

- CABC_SEL_ENA: CABC Manual Setting Enable
- CABC_SEL[3:0]: CABC Manual Gamma Curve Select



Default

Status	Default Value
OTP un-programmed	No OTP Support
OTP Programmed	No OTP Support

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5.3.32. CABCSET2 (C800h): CABC gamma curve setting

Address	C8h										
Address (SPI/I2C/MDDI)	C800h~C811 (0x01st ~0x12th parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	0	0	0	
Parameter 1	Write/Read		CABC2[3:0]				CABC1[3:0]				80h
Parameter 2	Write/Read		CABC4[3:0]				CABC3[3:0]				88h
Parameter 3	Write/Read		CABC6[3:0]				CABC5[3:0]				88h
Parameter 4	Write/Read		CABC8[3:0]				CABC7[3:0]				88h
Parameter 5	Write/Read		CABC10[3:0]				CABC9[3:0]				88h
Parameter 6	Write/Read		CABC12[3:0]				CABC11[3:0]				88h
Parameter 7	Write/Read		CABC14[3:0]				CABC13[3:0]				88h
Parameter 8	Write/Read		CABC16[3:0]				CABC15[3:0]				88h
Parameter 9	Write/Read		CABC18[3:0]				CABC17[3:0]				88h
Parameter 10	Write/Read		CABC20[3:0]				CABC19[3:0]				88h
Parameter 11	Write/Read		CABC22[3:0]				CABC21[3:0]				88h
Parameter 12	Write/Read		CABC24[3:0]				CABC23[3:0]				88h
Parameter 13	Write/Read		CABC26[3:0]				CABC25[3:0]				88h
Parameter 14	Write/Read		CABC28[3:0]				CABC27[3:0]				88h
Parameter 15	Write/Read		CABC30[3:0]				CABC29[3:0]				88h
Parameter 16	Write/Read		CABC32[3:0]				CABC31[3:0]				88h
Parameter 17	Write/Read		CABC34[3:0]				CABC33[3:0]				88h
Parameter 18	Write/Read		CABC36[3:0]				CABC35[3:0]				88h

Description	- CABCx[3:0] (x=1~18): Command C8h totally has 18 parameters, these parameters are settings for CABC gamma curve
Default	Status: OTP un-programmed → Default Value: Set as default value Status: OTP Programmed → Default Value: Set as OTP value

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5.3.33. AIESET(C900h): AIE Setting

Address (MIPI)	C9h										
Address (Other I/F)	C900h										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	0	0	1	C9h
1st Parameter	Write/Read		AIE2[3:0]				AIE1[3:0]				80h
2nd Parameter	Write/Read		AIE4[3:0]				AIE3[3:0]				88h
:	Write/Read		:				:				88h
17th Parameter	Write/Read		AIE34[3:0]				AIE33[3:0]				88h
18th Parameter	Write/Read		AIE36[3:0]				AIE35[3:0]				88h

Description	- Command C9h totally has 18 parameters, these parameters are settings for AIE gamma curve
Default	Status: OTP un-programmed → Default Value: Set as default value Status: OTP Programmed → Default Value: Set as OTP value

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5.3.34. PANCTRLSET1(CB80h~CB89h) Panel Control Setting 1

Address	CBh										
Address (SPI/I2C/MDDI)	CB80h ~ CB89h (0x81st ~ 0x8Ath parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	0	1	1	
0x81st Parameter	Write/Read		panelif_enmode_slpin1[7:0]								00h
0x82nd Parameter	Write/Read		panelif_enmode_slpin2[7:0]								00h
0x83rd Parameter	Write/Read		panelif_enmode_slpin3[7:0]								00h
0x84th Parameter	Write/Read		panelif_enmode_slpin4[7:0]								00h
0x85th Parameter	Write/Read		panelif_enmode_slpin5[7:0]								00h
0x86th Parameter	Write/Read		panelif_enmode_slpin6[7:0]								00h
0x87th Parameter	Write/Read		panelif_enmode_slpin7[7:0]								00h
0x88th Parameter	Write/Read		panelif_enmode_slpin8[7:0]								00h
0x89th Parameter	Write/Read		panelif_enmode_slpin9[7:0]								00h
0x8Ath Parameter	Write/Read		panelif_enmode_slpin10[7:0]								00h

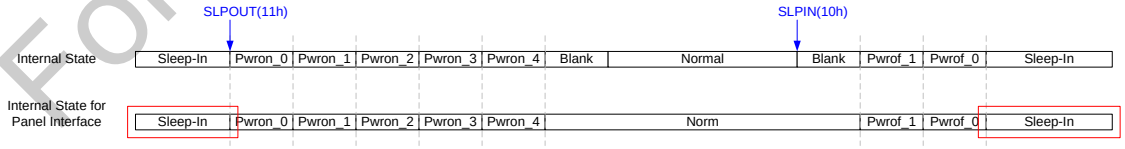
Description

These parameters are used to control GOA PAD output level during Sleep-In mode. Each PAD requires 2bit as enmode control. The mapping of enmod for each signal is as follows:

Parameters	Bit[7:6]	Bit[5:4]	Bit[3:2]	Bit[1:0]
panelif_enmode_slpin1[7:0]	enmode_sig4[1:0]	enmode_sig3[1:0]	enmode_sig2[1:0]	enmode_sig1[1:0]
panelif_enmode_slpin2[7:0]	enmode_sig8[1:0]	enmode_sig7[1:0]	enmode_sig6[1:0]	enmode_sig5[1:0]
panelif_enmode_slpin3[7:0]	enmode_sig12[1:0]	enmode_sig11[1:0]	enmode_sig10[1:0]	enmode_sig9[1:0]
panelif_enmode_slpin4[7:0]	enmode_sig16[1:0]	enmode_sig15[1:0]	enmode_sig14[1:0]	enmode_sig13[1:0]
panelif_enmode_slpin5[7:0]	enmode_sig20[1:0]	enmode_sig19[1:0]	enmode_sig18[1:0]	enmode_sig17[1:0]
panelif_enmode_slpin6[7:0]	enmode_sig24[1:0]	enmode_sig23[1:0]	enmode_sig22[1:0]	enmode_sig21[1:0]
panelif_enmode_slpin7[7:0]	enmode_sig28[1:0]	enmode_sig27[1:0]	enmode_sig26[1:0]	enmode_sig25[1:0]
panelif_enmode_slpin8[7:0]	enmode_sig32[1:0]	enmode_sig31[1:0]	enmode_sig30[1:0]	enmode_sig29[1:0]
panelif_enmode_slpin9[7:0]	enmode_sig36[1:0]	enmode_sig35[1:0]	enmode_sig34[1:0]	enmode_sig33[1:0]
panelif_enmode_slpin10[7:0]	enmode_sig40[1:0]	enmode_sig39[1:0]	enmode_sig38[1:0]	enmode_sig37[1:0]

enmode[1:0]	GOA signal output level
00	always VGL
01	Waveform matches internal tcon_goa signals
10	always VSS
11	always VGH

Controls the GOA PAD output level during sleep-in state.



Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.35. PANCTRLSET2(CB90h~CB9Eh) Panel Control Setting 2

Address	CBh										
Address (SPI/I2C/MDDI)	CB90h ~ CB9Eh (0x91st ~ 0x9Fth parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	0	1	1	
0x91st Parameter	Write/Read		panelif_enmode_l01[7:0]								00h
0x92nd Parameter	Write/Read		panelif_enmode_l02[7:0]								00h
0x93rd Parameter	Write/Read		panelif_enmode_l03[7:0]								00h
0x94th Parameter	Write/Read		panelif_enmode_l04[7:0]								00h
0x95th Parameter	Write/Read		panelif_enmode_l05[7:0]								00h
0x96th Parameter	Write/Read		panelif_enmode_l06[7:0]								00h
0x97th Parameter	Write/Read		panelif_enmode_l07[7:0]								00h
0x98th Parameter	Write/Read		panelif_enmode_l08[7:0]								00h
0x99th Parameter	Write/Read		panelif_enmode_l09[7:0]								00h
0x9Ath Parameter	Write/Read		panelif_enmode_l10[7:0]								00h
0x9Bth Parameter	Write/Read		panelif_enmode_l11[7:0]								00h
0x9Cth Parameter	Write/Read		panelif_enmode_l12[7:0]								00h
0x9Dth Parameter	Write/Read		panelif_enmode_l13[7:0]								00h
0x9Eth Parameter	Write/Read		panelif_enmode_l14[7:0]								00h
0x9Fth Parameter	Write/Read		panelif_enmode_l15[7:0]								00h

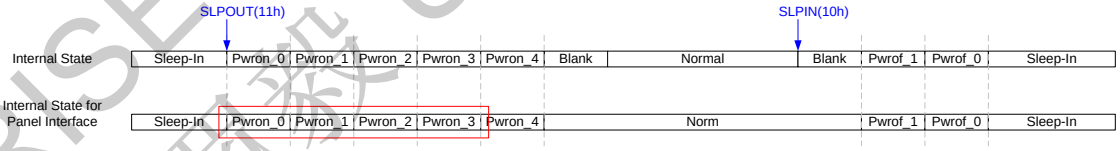
Description

These parameters are used to control GOA PAD output level during different stages of the power-on sequence for PAD 1~15.

Parameters	Bit[7:6]	Bit[5:4]	Bit[3:2]	Bit[1:0]
panelif_enmode_lnn[7:0] (Note 1)	enmode pwron_3[1:0]	enmode pwron_2[1:0]	enmode pwron_1[1:0]	enmode pwron_0[1:0]

Note 1: nn = 01 ~ 15

Controls GOA PAD output level during part of the power-on sequence



Please refer to PANCTRLSET1 for enmode setting description.

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.36. PANCTRLSET3(CBA0h~CBAEh) Panel Control Setting 3

Address	CBh										
Address (SPI/I2C/MDDI)	CBA0h ~ CBAEh (0xA1st ~ 0xAFth parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	0	1	1	
0xA1st Parameter	Write/Read		panelif_enmode_l16[7:0]								00h
0xA2nd Parameter	Write/Read		panelif_enmode_l17[7:0]								00h
0xA3rd Parameter	Write/Read		panelif_enmode_l18[7:0]								00h
0xA4th Parameter	Write/Read		panelif_enmode_l19[7:0]								00h
0xA5th Parameter	Write/Read		panelif_enmode_l20[7:0]								00h
0xA6th Parameter	Write/Read		panelif_enmode_l21[7:0]								00h
0xA7th Parameter	Write/Read		panelif_enmode_l22[7:0]								00h
0xa8th Parameter	Write/Read		panelif_enmode_l23[7:0]								00h
0xA9th Parameter	Write/Read		panelif_enmode_l24[7:0]								00h
0xAAth Parameter	Write/Read		panelif_enmode_l25[7:0]								00h
0xABth Parameter	Write/Read		panelif_enmode_l26[7:0]								00h
0xACth Parameter	Write/Read		panelif_enmode_l27[7:0]								00h
0xADth Parameter	Write/Read		panelif_enmode_l28[7:0]								00h
0xAEth Parameter	Write/Read		panelif_enmode_l29[7:0]								00h
0xAFth Parameter	Write/Read		panelif_enmode_l30[7:0]								00h

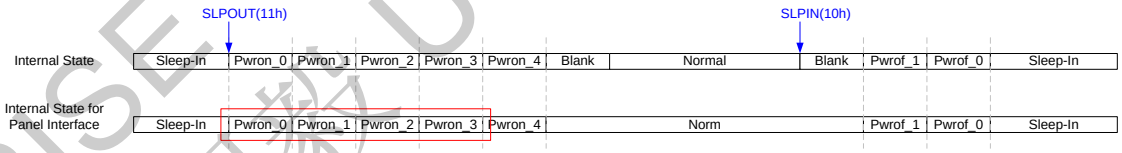
Description

These parameters are used to control GOA signal output level during different stages of the power-on sequence for PAD 16~30.

Parameters	Bit[7:6]	Bit[5:4]	Bit[3:2]	Bit[1:0]
panelif_enmode_lnn[7:0] (Note 1)	enmode pwron_3[1:0]	enmode pwron_2[1:0]	enmode pwron_1[1:0]	enmode pwron_0[1:0]

Note 1: nn = 16 ~ 30

Controls GOA PAD output level during part of the power-on sequence



Please refer to PANCTRLSET1 for enmode setting description.

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.37. PANCTRLSET4(CBB0h~CBB9h) Panel Control Setting 4

Address	CBh										
Address (SPI/I2C/MDDI)	CBB0h ~ CBB9h (0xB1st ~ 0xBAth parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	0	1	1	
0xB1st Parameter	Write/Read		panelif_enmode_l31[7:0]								00h
0xB2nd Parameter	Write/Read		panelif_enmode_l32[7:0]								00h
0xB3rd Parameter	Write/Read		panelif_enmode_l33[7:0]								00h
0xB4th Parameter	Write/Read		panelif_enmode_l34[7:0]								00h
0xB5th Parameter	Write/Read		panelif_enmode_l35[7:0]								00h
0xB6th Parameter	Write/Read		panelif_enmode_l36[7:0]								00h
0xB7th Parameter	Write/Read		panelif_enmode_l37[7:0]								00h
0xB8th Parameter	Write/Read		panelif_enmode_l38[7:0]								00h
0xB9th Parameter	Write/Read		panelif_enmode_l39[7:0]								00h
0xBAth Parameter	Write/Read		panelif_enmode_l40[7:0]								00h

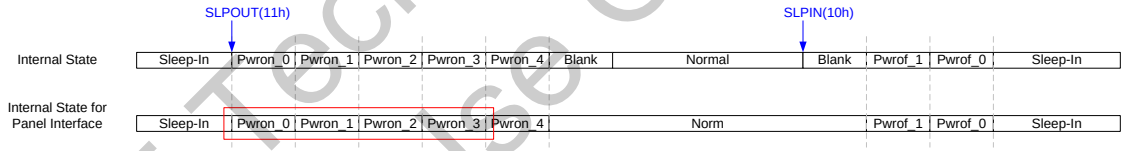
Description

These parameters are used to control GOA signal output level during different stages of the power-on sequence for PAD 31~40.

Parameters	Bit[7:6]	Bit[5:4]	Bit[3:2]	Bit[1:0]
panelif_enmode_lnn[7:0] (Note 1)	enmode pwron_3[1:0]	enmode pwron_2[1:0]	enmode pwron_1[1:0]	enmode pwron_0[1:0]

Note 1: nn = 31 ~ 40

Controls GOA PAD output level during part of the power-on sequence



Please refer to PANCTRLSET1 for enmode setting description.

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.38. PANCTRLSET5(CBC0h~CBCEh) Panel Control Setting 5

Address	CBh										
Address (SPI/I2C/MDDI)	CBC0h ~ CBCEh (0xC1st ~ 0xCFth parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	0	1	1	
0xC1st Parameter	Write/Read		panelif_enmode_h01[7:0]								04h
0xC2nd Parameter	Write/Read		panelif_enmode_h02[7:0]								00h
0xC3rd Parameter	Write/Read		panelif_enmode_h03[7:0]								04h
0xC4th Parameter	Write/Read		panelif_enmode_h04[7:0]								04h
0xC5th Parameter	Write/Read		panelif_enmode_h05[7:0]								04h
0xC6th Parameter	Write/Read		panelif_enmode_h06[7:0]								04h
0xC7th Parameter	Write/Read		panelif_enmode_h07[7:0]								04h
0xC8th Parameter	Write/Read		panelif_enmode_h08[7:0]								00h
0xC9th Parameter	Write/Read		panelif_enmode_h09[7:0]								00h
0xCAth Parameter	Write/Read		panelif_enmode_h10[7:0]								00h
0xCBth Parameter	Write/Read		panelif_enmode_h11[7:0]								00h
0xCCth Parameter	Write/Read		panelif_enmode_h12[7:0]								00h
0xCDth Parameter	Write/Read		panelif_enmode_h13[7:0]								00h
0xCEth Parameter	Write/Read		panelif_enmode_h14[7:0]								00h
0xCFth Parameter	Write/Read		panelif_enmode_h15[7:0]								00h

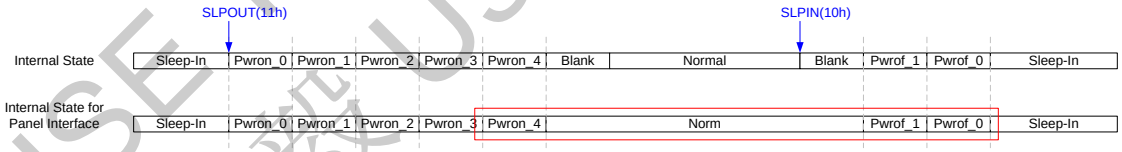
Description

These parameters are used to control GOA PAD output level during different stages of the power sequence for PAD 1~15.

Parameters	Bit[7:6]	Bit[5:4]	Bit[3:2]	Bit[1:0]
panelif_enmode_hnn[7:0] (Note 1)	enmode pwrof_0[1:0]	enmode pwron_1[1:0]	enmode norm[1:0]	enmode pwron_4[1:0]

Note 1: nn = 01 ~ 15

Controls GOA PAD output level during other other different stages of the power sequence.



Please refer to PANCTRLSET1 for enmode setting description.

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.39. PANCTRLSET6(CBD0h~CBDEh) Panel Control Setting 6

Address	CBh										
Address (SPI/I2C/MDDI)	CBD0h ~ CBDEh (0xD1st ~ 0xDFth parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	0	1	1	
0xD1st Parameter	Write/Read		panelif_enmode_h16[7:0]								00h
0xD2nd Parameter	Write/Read		panelif_enmode_h17[7:0]								00h
0xD3rd Parameter	Write/Read		panelif_enmode_h18[7:0]								00h
0xD4th Parameter	Write/Read		panelif_enmode_h19[7:0]								00h
0xD5th Parameter	Write/Read		panelif_enmode_h20[7:0]								00h
0xD6th Parameter	Write/Read		panelif_enmode_h21[7:0]								04h
0xD7th Parameter	Write/Read		panelif_enmode_h22[7:0]								00h
0xD8th Parameter	Write/Read		panelif_enmode_h23[7:0]								04h
0xD9th Parameter	Write/Read		panelif_enmode_h24[7:0]								04h
0xDAth Parameter	Write/Read		panelif_enmode_h25[7:0]								04h
0xDBth Parameter	Write/Read		panelif_enmode_h26[7:0]								04h
0xDCth Parameter	Write/Read		panelif_enmode_h27[7:0]								04h
0xDDth Parameter	Write/Read		panelif_enmode_h28[7:0]								00h
0xDEth Parameter	Write/Read		panelif_enmode_h29[7:0]								00h
0xDFth Parameter	Write/Read		panelif_enmode_h30[7:0]								00h

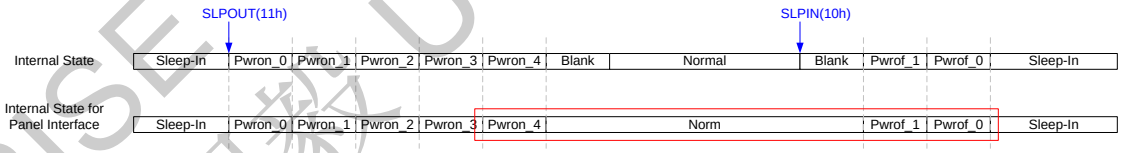
Description

These parameters are used to control GOA PAD output level during different stages of the power sequence for PAD 16~30.

Parameters	Bit[7:6]	Bit[5:4]	Bit[3:2]	Bit[1:0]
panelif_enmode_hnn[7:0] (Note 1)	enmode pwrof_0[1:0]	enmode pwron_1[1:0]	enmode norm[1:0]	enmode pwron_4[1:0]

Note 1: nn = 16 ~ 30

Controls GOA PAD output level during other other different stages of the power sequence.



Please refer to PANCTRLSET1 for enmode setting description.

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.40. PANCTRLSET7(CBE0h~CBF9h) Panel Control Setting 7

Address	CBh										
Address (SPI/I2C/MDDI)	CBE0h ~ CBE9h (0xE1st ~ 0xEAth parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	0	1	1	
0xE1st Parameter	Write/Read		panelif_enmode_h31[7:0]								00h
0xE2nd Parameter	Write/Read		panelif_enmode_h32[7:0]								00h
0xE3rd Parameter	Write/Read		panelif_enmode_h33[7:0]								00h
0xE4th Parameter	Write/Read		panelif_enmode_h34[7:0]								00h
0xE5th Parameter	Write/Read		panelif_enmode_h35[7:0]								00h
0xE6th Parameter	Write/Read		panelif_enmode_h36[7:0]								00h
0xE7th Parameter	Write/Read		panelif_enmode_h37[7:0]								00h
0xE8th Parameter	Write/Read		panelif_enmode_h38[7:0]								00h
0xE9th Parameter	Write/Read		panelif_enmode_h39[7:0]								00h
0xEAth Parameter	Write/Read		panelif_enmode_h40[7:0]								00h

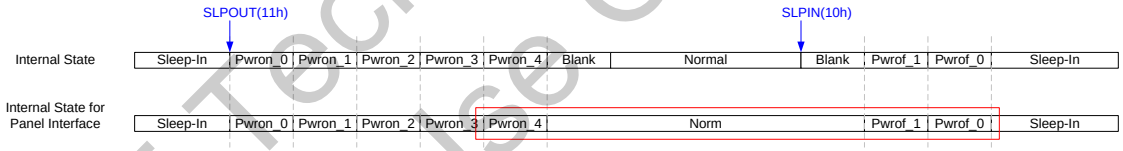
Description

These parameters are used to control GOA PAD output level during different stages of the power sequence for PAD 31~40.

Parameters	Bit[7:6]	Bit[5:4]	Bit[3:2]	Bit[1:0]
panelif_enmode_hnn[7:0] (Note 1)	enmode pwrof_0[1:0]	enmode pwron_1[1:0]	enmode norm[1:0]	enmode pwron_4[1:0]

Note 1: nn = 31 ~ 40

Controls GOA PAD output level during other other different stages of the power sequence.



Please refer to PANCTRLSET1 for enmode setting description.

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.41. PANCTRLSET8(CBF0h~CB89h) Panel Control Setting 8

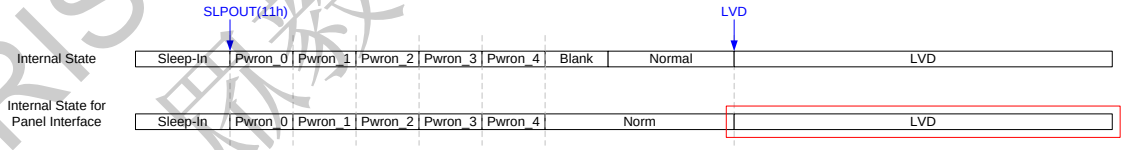
Address	CBh										
Address (SPI/I2C/MDDI)	CBF0h ~ CBF9h (0xF1st ~ 0xFAth parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	0	1	1	
0xF1st Parameter	Write/Read		panelif_enmode_lvd1[7:0]								FFh
0xF2nd Parameter	Write/Read		panelif_enmode_lvd2[7:0]								FFh
0xF3rd Parameter	Write/Read		panelif_enmode_lvd3[7:0]								FFh
0xF4th Parameter	Write/Read		panelif_enmode_lvd4[7:0]								FFh
0xF5th Parameter	Write/Read		panelif_enmode_lvd5[7:0]								FFh
0xF6th Parameter	Write/Read		panelif_enmode_lvd6[7:0]								FFh
0xF7th Parameter	Write/Read		panelif_enmode_lvd7[7:0]								FFh
0xF8th Parameter	Write/Read		panelif_enmode_lvd8[7:0]								FFh
0xF9th Parameter	Write/Read		panelif_enmode_lvd9[7:0]								FFh
0xFAth Parameter	Write/Read		panelif_enmode_lvd10[7:0]								FFh

Description

These parameters are used to control GOA PAD output level during LVD situation. Each PAD requires 2bit as enmode control. The mapping of enmod for each signal is as follows:

Parameters	Bit[7:6]	Bit[5:4]	Bit[3:2]	Bit[1:0]
panelif_enmode_lvd1[7:0]	enmode_sig4[1:0]	enmode_sig3[1:0]	enmode_sig2[1:0]	enmode_sig1[1:0]
panelif_enmode_lvd2[7:0]	enmode_sig8[1:0]	enmode_sig7[1:0]	enmode_sig6[1:0]	enmode_sig5[1:0]
panelif_enmode_lvd3[7:0]	enmode_sig12[1:0]	enmode_sig11[1:0]	enmode_sig10[1:0]	enmode_sig9[1:0]
panelif_enmode_lvd4[7:0]	enmode_sig16[1:0]	enmode_sig15[1:0]	enmode_sig14[1:0]	enmode_sig13[1:0]
panelif_enmode_lvd5[7:0]	enmode_sig20[1:0]	enmode_sig19[1:0]	enmode_sig18[1:0]	enmode_sig17[1:0]
panelif_enmode_lvd6[7:0]	enmode_sig24[1:0]	enmode_sig23[1:0]	enmode_sig22[1:0]	enmode_sig21[1:0]
panelif_enmode_lvd7[7:0]	enmode_sig28[1:0]	enmode_sig27[1:0]	enmode_sig26[1:0]	enmode_sig25[1:0]
panelif_enmode_lvd8[7:0]	enmode_sig32[1:0]	enmode_sig31[1:0]	enmode_sig30[1:0]	enmode_sig29[1:0]
panelif_enmode_lvd9[7:0]	enmode_sig36[1:0]	enmode_sig35[1:0]	enmode_sig34[1:0]	enmode_sig33[1:0]
panelif_enmode_lvd10[7:0]	enmode_sig40[1:0]	enmode_sig39[1:0]	enmode_sig38[1:0]	enmode_sig37[1:0]

Controls the GOA PAD output level during LVD situation.



Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.42. PANU2D1(CC80h~CC89h) Panel U2D Setting 1

Address	CCh										
Address (SPI/I2C/MDDI)	CC80h ~ CC89h (0x81st ~ 0x8Ath parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	1	0	0	
0x81st Parameter	Write/Read		0	0	panelif_u2d_sel01[5:0]						02h
0x82nd Parameter	Write/Read		0	0	panelif_u2d_sel02[5:0]						00h
0x83rd Parameter	Write/Read		0	0	panelif_u2d_sel03[5:0]						10h
0x84th Parameter	Write/Read		0	0	panelif_u2d_sel04[5:0]						0Eh
0x85th Parameter	Write/Read		0	0	panelif_u2d_sel05[5:0]						0Ch
0x86th Parameter	Write/Read		0	0	panelif_u2d_sel06[5:0]						0Ah
0x87th Parameter	Write/Read		0	0	panelif_u2d_sel07[5:0]						06h
0x88th Parameter	Write/Read		0	0	panelif_u2d_sel08[5:0]						00h
0x89th Parameter	Write/Read		0	0	panelif_u2d_sel09[5:0]						00h
0x8Ath Parameter	Write/Read		0	0	panelif_u2d_sel10[5:0]						00h

Description

These parameters are used to map internal GOA signals to GOA output pad for normal scan (U2D).

example:

To assign tcon_goa_clka1 to GOA Output PAD GOUT1 during normal scan, and

tcon_goa_clkb1 to GOA Output PAD GOUT1 during reverse scan

set panelif_u2d_sel01[5:0] = 9, and panelif_d2u_sel01[5:0] = 13

Internal Signal No.	Internal GOA Signal Name	U2D Parameter (normal scan)	D2U Parameter (reverse scan)	GOA Output PAD
1	tcon_goa_vst1	panelif_u2d_sel01[5:0]	panelif_d2u_sel01[5:0]	GOUT1
2	tcon_goa_vst2	panelif_u2d_sel02[5:0]	panelif_d2u_sel02[5:0]	GOUT2
3	tcon_goa_vst3	panelif_u2d_sel03[5:0]	panelif_d2u_sel03[5:0]	GOUT3
4	tcon_goa_vst4	panelif_u2d_sel04[5:0]	panelif_d2u_sel04[5:0]	GOUT4
5	tcon_goa_vend1	panelif_u2d_sel05[5:0]	panelif_d2u_sel05[5:0]	GOUT5
6	tcon_goa_vend2	panelif_u2d_sel06[5:0]	panelif_d2u_sel06[5:0]	GOUT6
7	tcon_goa_vend3	panelif_u2d_sel07[5:0]	panelif_d2u_sel07[5:0]	GOUT7
8	tcon_goa_vend4	panelif_u2d_sel08[5:0]	panelif_d2u_sel08[5:0]	GOUT8
9	tcon_goa_clka1	panelif_u2d_sel09[5:0]	panelif_d2u_sel09[5:0]	GOUT9
10	tcon_goa_clka2	panelif_u2d_sel10[5:0]	panelif_d2u_sel10[5:0]	GOUT10
11	tcon_goa_clka3	panelif_u2d_sel11[5:0]	panelif_d2u_sel11[5:0]	GOUT11
12	tcon_goa_clka4	panelif_u2d_sel12[5:0]	panelif_d2u_sel12[5:0]	GOUT12
13	tcon_goa_clkb1	panelif_u2d_sel13[5:0]	panelif_d2u_sel13[5:0]	GOUT13
14	tcon_goa_clkb2	panelif_u2d_sel14[5:0]	panelif_d2u_sel14[5:0]	GOUT14
15	tcon_goa_clkb3	panelif_u2d_sel15[5:0]	panelif_d2u_sel15[5:0]	GOUT15
16	tcon_goa_clkb4	panelif_u2d_sel16[5:0]	panelif_d2u_sel16[5:0]	GOUT16
17	tcon_goa_clkc1	panelif_u2d_sel17[5:0]	panelif_d2u_sel17[5:0]	N/A
18	tcon_goa_clkc2	panelif_u2d_sel18[5:0]	panelif_d2u_sel18[5:0]	N/A
19	tcon_goa_clkc3	panelif_u2d_sel19[5:0]	panelif_d2u_sel19[5:0]	N/A
20	tcon_goa_clkc4	panelif_u2d_sel20[5:0]	panelif_d2u_sel20[5:0]	N/A
21	tcon_goa_clkd1	panelif_u2d_sel21[5:0]	panelif_d2u_sel21[5:0]	GOUT32
22	tcon_goa_clkd2	panelif_u2d_sel22[5:0]	panelif_d2u_sel22[5:0]	GOUT31
23	tcon_goa_clkd3	panelif_u2d_sel23[5:0]	panelif_d2u_sel23[5:0]	GOUT30
24	tcon_goa_clkd4	panelif_u2d_sel24[5:0]	panelif_d2u_sel24[5:0]	GOUT29
25	tcno_goa_clksa12 *	panelif_u2d_sel25[5:0]	panelif_d2u_sel25[5:0]	GOUT28
26	tcno_goa_clksa34 *	panelif_u2d_sel26[5:0]	panelif_d2u_sel26[5:0]	GOUT27
27	tcno_goa_clksb12 *	panelif_u2d_sel27[5:0]	panelif_d2u_sel27[5:0]	GOUT26

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	28	tcno_goa_clksb34 *	panelif_u2d_sel28[5:0]	panelif_d2u_sel28[5:0]	GOUT25
	29	tcno_goa_clksc12 *	panelif_u2d_sel29[5:0]	panelif_d2u_sel29[5:0]	GOUT24
	30	tcno_goa_clksc34 *	panelif_u2d_sel30[5:0]	panelif_d2u_sel30[5:0]	GOUT23
	31	tcno_goa_clksd12 *	panelif_u2d_sel31[5:0]	panelif_d2u_sel31[5:0]	GOUT22
	32	tcno_goa_clksd34 *	panelif_u2d_sel32[5:0]	panelif_d2u_sel32[5:0]	GOUT21
	33	tcon_goa_eclk1	panelif_u2d_sel33[5:0]	panelif_d2u_sel33[5:0]	GOUT20
	34	tcon_goa_eclk2	panelif_u2d_sel34[5:0]	panelif_d2u_sel34[5:0]	GOUT19
	35	tcon_goa_eclk3	panelif_u2d_sel35[5:0]	panelif_d2u_sel35[5:0]	GOUT18
	36	tcon_goa_eclk4	panelif_u2d_sel36[5:0]	panelif_d2u_sel36[5:0]	GOUT17
	37	tcon_goa_dir1	panelif_u2d_sel37[5:0]	panelif_d2u_sel37[5:0]	N/A
	38	tcon_goa_dir2	panelif_u2d_sel38[5:0]	panelif_d2u_sel38[5:0]	N/A
	39	VSS	panelif_u2d_sel39[5:0]	panelif_d2u_sel39[5:0]	N/A
	40	VSS	panelif_u2d_sel40[5:0]	panelif_d2u_sel40[5:0]	N/A

* tcon_goa_clksa12, sa34, sb12, sb34, sc12, sc34, sd12, sd34 are logically gated signal

tcon_goa_clksa12 = tcon_goa_clka1 OR tcon_goa_clka2

tcon_goa_clksa34 = tcon_goa_clka3 OR tcon_goa_clka4

tcon_goa_clksb12 = tcon_goa_clkb1 OR tcon_goa_clkb2

tcon_goa_clksb34 = tcon_goa_clkb3 OR tcon_goa_clkb4

tcon_goa_clksc12 = tcon_goa_clkc1 OR tcon_goa_clkc2

tcon_goa_clksc34 = tcon_goa_clkc3 OR tcon_goa_clkc4

tcon_goa_clksd12 = tcon_goa_clkd1 OR tcon_goa_clkd2

tcon_goa_clksd34 = tcon_goa_clkd3 OR tcon_goa_clkd4

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.43. PANU2D2(CC90h~CC9Eh) Panel U2D Setting 2

Address	CCh										
Address (SPI/I2C/MDDI)	CC90h ~ CC9Eh (0x91st ~ 0x9Fth parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	1	0	0	
0x91st Parameter	Write/Read		0	0	panelif_u2d_sel11[5:0]						00h
0x92nd Parameter	Write/Read		0	0	panelif_u2d_sel12[5:0]						00h
0x93rd Parameter	Write/Read		0	0	panelif_u2d_sel13[5:0]						00h
0x94th Parameter	Write/Read		0	0	panelif_u2d_sel14[5:0]						00h
0x95th Parameter	Write/Read		0	0	panelif_u2d_sel15[5:0]						00h
0x96th Parameter	Write/Read		0	0	panelif_u2d_sel16[5:0]						00h
0x97th Parameter	Write/Read		0	0	panelif_u2d_sel17[5:0]						00h
0x98th Parameter	Write/Read		0	0	panelif_u2d_sel18[5:0]						00h
0x99th Parameter	Write/Read		0	0	panelif_u2d_sel19[5:0]						00h
0x9Ath Parameter	Write/Read		0	0	panelif_u2d_sel20[5:0]						00h
0x9Bth Parameter	Write/Read		0	0	panelif_u2d_sel21[5:0]						01h
0x9Cth Parameter	Write/Read		0	0	panelif_u2d_sel22[5:0]						00h
0x9Dth Parameter	Write/Read		0	0	panelif_u2d_sel23[5:0]						0Fh
0x9Eth Parameter	Write/Read		0	0	panelif_u2d_sel24[5:0]						0Dh
0x9Fth Parameter	Write/Read		0	0	panelif_u2d_sel25[5:0]						0Bh

Description	These parameters are used to map internal GOA signals to GOA output pad for normal scan (U2D). example: Please rever to PANU2D1 to internal goa signal to GOA PAD mapping table.
Default	Status: OTP un-programmed → Default Value: Set as default value Status: OTP Programmed → Default Value: Set as OTP value

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5.3.44. PANU2D3(CCA0h~CCAEh) Panel U2D Setting 3

Address	CCh										
Address (SPI/I2C/MDDI)	CCA0h ~ CCAEh (0xA1st ~ 0xAFth parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	1	0	0	
0xA1st Parameter	Write/Read		0	0	panelif_u2d_sel26[5:0]						09h
0xA2nd Parameter	Write/Read		0	0	panelif_u2d_sel27[5:0]						05h
0xA3rd Parameter	Write/Read		0	0	panelif_u2d_sel28[5:0]						00h
0xA4th Parameter	Write/Read		0	0	panelif_u2d_sel29[5:0]						00h
0xA5th Parameter	Write/Read		0	0	panelif_u2d_sel30[5:0]						00h
0xA6th Parameter	Write/Read		0	0	panelif_u2d_sel31[5:0]						00h
0xA7th Parameter	Write/Read		0	0	panelif_u2d_sel32[5:0]						00h
0xA8th Parameter	Write/Read		0	0	panelif_u2d_sel33[5:0]						00h
0xA9th Parameter	Write/Read		0	0	panelif_u2d_sel34[5:0]						00h
0xAAth Parameter	Write/Read		0	0	panelif_u2d_sel35[5:0]						00h
0xABth Parameter	Write/Read		0	0	panelif_u2d_sel36[5:0]						00h
0xACth Parameter	Write/Read		0	0	panelif_u2d_sel37[5:0]						00h
0xADth Parameter	Write/Read		0	0	panelif_u2d_sel38[5:0]						00h
0xAEth Parameter	Write/Read		0	0	panelif_u2d_sel39[5:0]						00h
0xAFth Parameter	Write/Read		0	0	panelif_u2d_sel40[5:0]						00h

Description	These parameters are used to map internal GOA signals to GOA output pad for normal scan (U2D). example: Please rever to PANU2D1 to internal goa signal to GOA PAD mapping table.
Default	Status: OTP un-programmed → Default Value: Set as default value Status: OTP Programmed → Default Value: Set as OTP value

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5.3.45. PAND2U1(CCB0h~CCB9h) Panel D2U Setting 1

Address	CCh										
Address (SPI/I2C/MDDI)	CCB0h ~ CCB9h (0xB1st ~ 0xBAth parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	1	0	0	
0xB1st Parameter	Write/Read		0	0	panelif_d2u_sel01[5:0]						08h
0xB2nd Parameter	Write/Read		0	0	panelif_d2u_sel02[5:0]						00h
0xB3rd Parameter	Write/Read		0	0	panelif_d2u_sel03[5:0]						18h
0xB4th Parameter	Write/Read		0	0	panelif_d2u_sel04[5:0]						16h
0xB5th Parameter	Write/Read		0	0	panelif_d2u_sel05[5:0]						14h
0xB6th Parameter	Write/Read		0	0	panelif_d2u_sel06[5:0]						12h
0xB7th Parameter	Write/Read		0	0	panelif_d2u_sel07[5:0]						04h
0xB8th Parameter	Write/Read		0	0	panelif_d2u_sel08[5:0]						00h
0xB9th Parameter	Write/Read		0	0	panelif_d2u_sel09[5:0]						00h
0xBAth Parameter	Write/Read		0	0	panelif_d2u_sel10[5:0]						00h

Description	These parameters are used to map internal GOA signals to GOA output pad for reverse scan (D2U). Please rever to PANU2D1 to internal goa signal to GOA PAD mapping table.
Default	Status: OTP un-programmed → Default Value: Set as default value Status: OTP Programmed → Default Value: Set as OTP value

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5.3.46. PAND2U2(CCC0h~CCCEh) Panel D2U Setting 2

Address	CCh										
Address (SPI/I2C/MDDI)	CCC0h ~ CCCEh (0xC1st ~ 0xCFth parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	1	0	0	
0xC1st Parameter	Write/Read		0	0	panelif_d2u_sel11[5:0]						00h
0xC2nd Parameter	Write/Read		0	0	panelif_d2u_sel12[5:0]						00h
0xC3rd Parameter	Write/Read		0	0	panelif_d2u_sel13[5:0]						00h
0xC4th Parameter	Write/Read		0	0	panelif_d2u_sel14[5:0]						00h
0xC5th Parameter	Write/Read		0	0	panelif_d2u_sel15[5:0]						00h
0xC6th Parameter	Write/Read		0	0	panelif_d2u_sel16[5:0]						00h
0xC7th Parameter	Write/Read		0	0	panelif_d2d_sel17[5:0]						00h
0xC8th Parameter	Write/Read		0	0	panelif_d2u_sel18[5:0]						00h
0xC9th Parameter	Write/Read		0	0	panelif_d2u_sel19[5:0]						00h
0xCAth Parameter	Write/Read		0	0	panelif_d2u_sel20[5:0]						00h
0xCBth Parameter	Write/Read		0	0	panelif_d2u_sel21[5:0]						07h
0xCCth Parameter	Write/Read		0	0	panelif_d2u_sel22[5:0]						00h
0xCDth Parameter	Write/Read		0	0	panelif_d2u_sel23[5:0]						17h
0xCEth Parameter	Write/Read		0	0	panelif_d2u_sel24[5:0]						15h
0xCFth Parameter	Write/Read		0	0	panelif_d2u_sel25[5:0]						13h

Description	These parameters are used to map internal GOA signals to GOA output pad for normal scan (D2U). example: Please rever to PANU2D1 to internal goa signal to GOA PAD mapping table.
Default	Status: OTP un-programmed — Default Value: Set as default value Status: OTP Programmed — Default Value: Set as OTP value

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5.3.47. PAND2U3(CCD0h~CCDEh) Panel D2U Setting 3

Address	CCh										
Address (SPI/I2C/MDDI)	CCd0h ~ CCDEh (0xD1st ~ 0xDFth parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	1	0	0	
0xD1st Parameter	Write/Read		0	0	panelif_d2u_sel26[5:0]						11h
0xD2nd Parameter	Write/Read		0	0	panelif_d2u_sel27[5:0]						03h
0xD3rd Parameter	Write/Read		0	0	panelif_d2u_sel28[5:0]						00h
0xD4th Parameter	Write/Read		0	0	panelif_d2u_sel29[5:0]						00h
0xD5th Parameter	Write/Read		0	0	panelif_d2u_sel30[5:0]						00h
0xD6th Parameter	Write/Read		0	0	panelif_d2u_sel31[5:0]						00h
0xD7th Parameter	Write/Read		0	0	panelif_d2u_sel32[5:0]						00h
0xD8th Parameter	Write/Read		0	0	panelif_d2u_sel33[5:0]						00h
0xD9th Parameter	Write/Read		0	0	panelif_d2u_sel34[5:0]						00h
0xDAth Parameter	Write/Read		0	0	panelif_d2u_sel35[5:0]						00h
0xDBth Parameter	Write/Read		0	0	panelif_d2u_sel36[5:0]						00h
0xDCth Parameter	Write/Read		0	0	panelif_d2u_sel37[5:0]						00h
0xDDth Parameter	Write/Read		0	0	panelif_d2u_sel38[5:0]						00h
0xDEth Parameter	Write/Read		0	0	panelif_d2u_sel39[5:0]						00h
0xDFth Parameter	Write/Read		0	0	panelif_d2u_sel40[5:0]						00h

Description	These parameters are used to map internal GOA signals to GOA output pad for normal scan (D2U). example: Please rever to PANU2D1 to internal goa signal to GOA PAD mapping table.
Default	Status: OTP un-programmed → Default Value: Set as default value Status: OTP Programmed → Default Value: Set as OTP value

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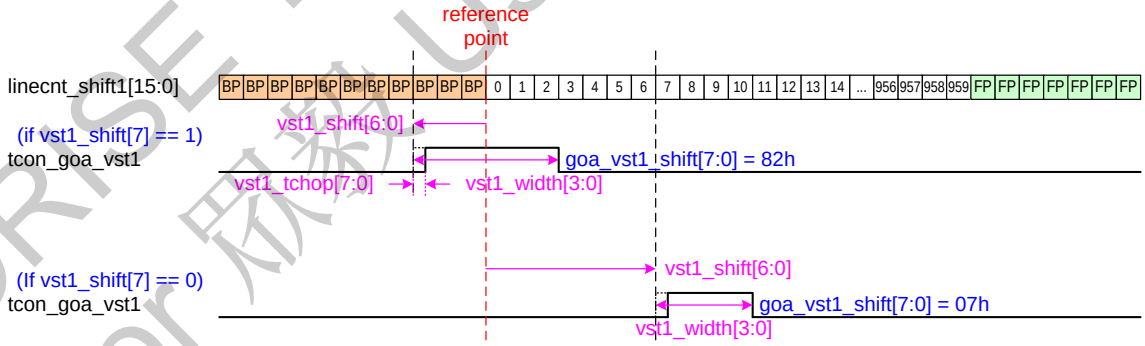
5.3.48. GOAVST(CE80h~CE8Bh) GOA VST Setting

Address	CEh										
Address (SPI/I2C/MDDI)	CE80h ~ CE8Bh (0x81st ~ 0x8Cth parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	1	1	0	
0x81st Parameter	Write/Read		vst1_shift[7:0]								82h
0x82nd Parameter	Write/Read		0	0	0	0	vst1_width[3:0]				01h
0x83rd Parameter	Write/Read		vst1_tchop[7:0]								28h
0x84th Parameter	Write/Read		vst2_shift[7:0]								81h
0x85th Parameter	Write/Read		0	0	0	0	vst2_width[3:0]				01h
0x86th Parameter	Write/Read		vst2_tchop[7:0]								28h
0x87th Parameter	Write/Read		vst3_shift[7:0]								81h
0x88th Parameter	Write/Read		0	0	0	0	vst3_width[3:0]				01h
0x89th Parameter	Write/Read		vst3_tchop[7:0]								28h
0x8Ath Parameter	Write/Read		vst4_shift[7:0]								82h
0x8Bth Parameter	Write/Read		0	0	0	0	vst4_width[3:0]				01h
0x8Cth Parameter	Write/Read		vst4_tchop[7:0]								28h

Description

These parameters are used to create single pulse type signals tcon_goa_vst1, tcon_goa_vst2, tcon_goa_vst3 and tcon_goa_vst4.

Parameters	Description
vst1_shift[7]	0: tcon_goa_vst1 rising edge locates after reference point 1: tcon_goa_vst1 rising edge locates before reference point, in BP region
vst1_shift[6:0]	Set starting position of the tcon_goa_vst1 pulse with respect to the reference point
vst1_width[3:0]	Set tcon_goa_vst1 pulse width = vst1_width[3:0] + 1 (unit = line)
vst1_tchop[7:0]	Delay rising edge of tcon_goa_vst1 signal (unit = mclk)



- Use other parameters and apply the same method to create tcon_goa_vst2, tcon_goa_vst3 and tcon_goa_vst4 signals

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.49. GOAVEND(CE90h~CE9Bh) GOA VEND Setting

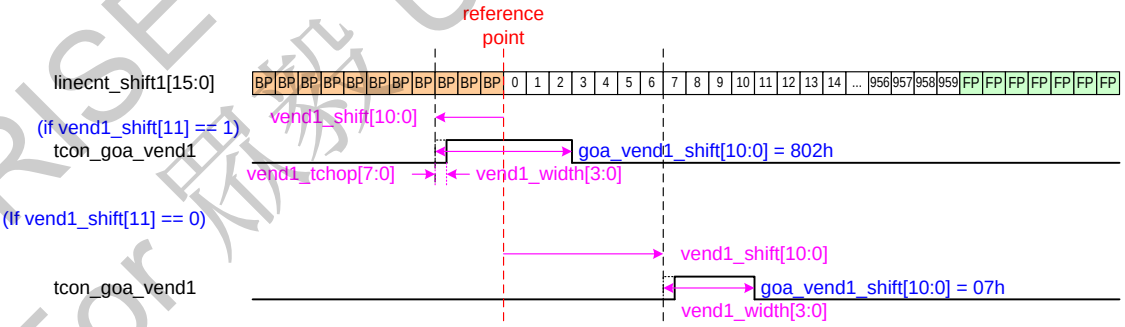
Address	CEh										
Address (SPI/I2C/MDDI)	CE90h ~ CE9Bh (0x91st ~ 0x9Cth parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	1	1	0	
0x91st Parameter	Write/Read		vend1_width[3:0]				vend1_shift[11:8]				13h
0x92nd Parameter	Write/Read		vend1_shift[7:0]								1Fh
0x93rd Parameter	Write/Read		vend1_tchop[7:0]								28h
0x94th Parameter	Write/Read		vend2_width[3:0]				vend2_shift[11:8]				13h
0x95th Parameter	Write/Read		vend2_shift[7:0]								20h
0x96th Parameter	Write/Read		vend2_tchop[7:0]								28h
0x97th Parameter	Write/Read		vend3_width[3:0]				vend3_shift[11:8]				13h
0x98th Parameter	Write/Read		vend3_shift[7:0]								20h
0x99th Parameter	Write/Read		vend3_tchop[7:0]								28h
0x9Ath Parameter	Write/Read		vend4_width[3:0]				vend4_shift[11:8]				13h
0x9Bth Parameter	Write/Read		vend4_shift[7:0]								1Fh
0x9Cth Parameter	Write/Read		vend4_tchop[7:0]								28h

NOTE: "-" Don't care, can be set to VDDIO or VSS level

Description

These parameters are used to create single pulse type signals tcon_goa_vst1, tcon_goa_vst2, tcon_goa_vst3 and tcon_goa_vst4.

Parameters	Description
vend1_shift[11]	0: tcon_goa_vend1 rising edge locates after reference point 1: tcon_goa_vend1 rising edge locates before reference point, in BP region
vend1_shift[10:0]	Set starting position of the tcon_goa_vend1 pulse with respect to the reference point
vend1_width[3:0]	Set tcon_goa_vend1 pulse width = vend1_width[3:0] + 1 (unit = line)
vend1_tchop[7:0]	Delay rising edge of tcon_goa_vend1 signal (unit = mclk)



- Use other parameters and apply the same method to create tcon_goa_vend2, tcon_goa_vend3 and tcon_goa_vend4 signals

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.50. GOAGPSET(CE9Ch~CE9Dh) GOA Group Setting

Address	CEh										
Address (SPI/I2C/MDDI)	CE9Ch ~ CE9Dh (0x9Dst ~ 0x9Eth parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	1	1	0	
0x9Dst Parameter	Write/Read		clka1_ group1	clka2_ group1	clka3_ group1	clka4_ group1	clkb1_ group1	clkb2_ group1	clkb3_ group1	clkb4_ group1	00h
0x9End Parameter	Write/Read		clkc1_ group1	clkc2_ group1	clkc3_ group1	clkc4_ group1	clkd1_ group1	clkd2_ group1	clkd3_ group1	clkd4_ group1	00h

Description

These parameters are used to control the tcon_goa_clkx timing in the head and tail region as to where the rising or falling edge should align to.

Parameters	Description
clka1_group1	0: the edge of tcon_goa_clka1 head and tail region aligns with edges of tcon_goa_vst2 1: the edge of tcon_goa_clka1 head and rail region aligns with edges of tcon_goa_vst1
clka2_group1	0: the edge of tcon_goa_clka2 head and tail region aligns with edges of tcon_goa_vst2 1: the edge of tcon_goa_clka2 head and rail region aligns with edges of tcon_goa_vst1
clka3_group1	0: the edge of tcon_goa_clka3 head and tail region aligns with edges of tcon_goa_vst2 1: the edge of tcon_goa_clka3 head and rail region aligns with edges of tcon_goa_vst1
clka4_group1	0: the edge of tcon_goa_clka4 head and tail region aligns with edges of tcon_goa_vst2 1: the edge of tcon_goa_clka4 head and rail region aligns with edges of tcon_goa_vst1

Use the remaining parameters and apply the same method control signal behavior of tcon_goa_clkb1~b4, tcon_goa_clkc1~c4, tcon_goa_clkd1~d4.

Please refer to figures in 5.3.51 for definition of head and tail region of the clock signals and other parameters that controls the signal behavior in the head and tail region.

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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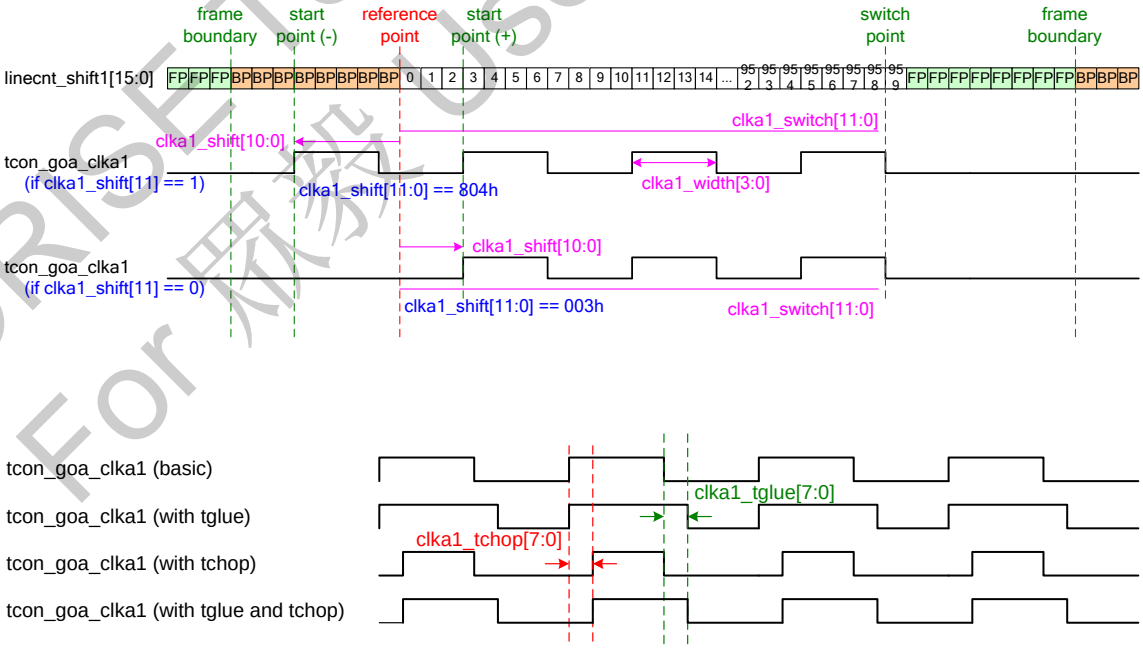
5.3.51. GOACLKA1(CEA0h~CEA6h) GOA CLKA1 Setting

Address	CEh										
Address (SPI/I2C/MDDI)	CEA0h ~ CEA6h (0xA1st ~ 0xA7th parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	1	1	0	
0xA1st Parameter	Write/Read		clka1_width[3:0]				clka1_shift[11:8]				18h
0xA2nd Parameter	Write/Read		clka1_shift[7:0]								00h
0xA3rd Parameter	Write/Read		clka1_sw_tg	clka1_odd_hi	clka1_f_head	clka1_f_tail	clka1_switch[11:8]				03h
0xA4th Parameter	Write/Read		clka1_switch[7:0]								1Dh
0xA5th Parameter	Write/Read		clka1_extend[7:0]								00h
0xA6th Parameter	Write/Read		clka1_tchop[7:0]								28h
0xA7th Parameter	Write/Read		clka1_tglue[7:0]								00h

Description

These parameters are used to create clock type signal tcon_goa_clka1

Basic Setting Parameters	Description
clka1_shift[11]	0: tcon_goa_clka1 rising edge starting point locates after reference point 1: tcon_goa_clka1 rising edge starting point locates before reference point, in BP region
clka1_shift[10:0]	Specifies start point of tcon_goa_clka1 where the clock starts to toggle
clka1_width[3:0]	Set half-period of the tcon_goa_clka1 signal, half period = clka1_width[3:0] + 1 (unit = line)
clka1_switch[11:0]	Set ending position of the tcon_goa_clka1 signal with respect to the reference point
clka1_tchop[7:0]	Delay rising edge of tcon_goa_clka1 signal (unit = mclk)
clka1_tglue[7:0]	Delay falling edge of tcon_goa_clka1 signal (unit = mclk)



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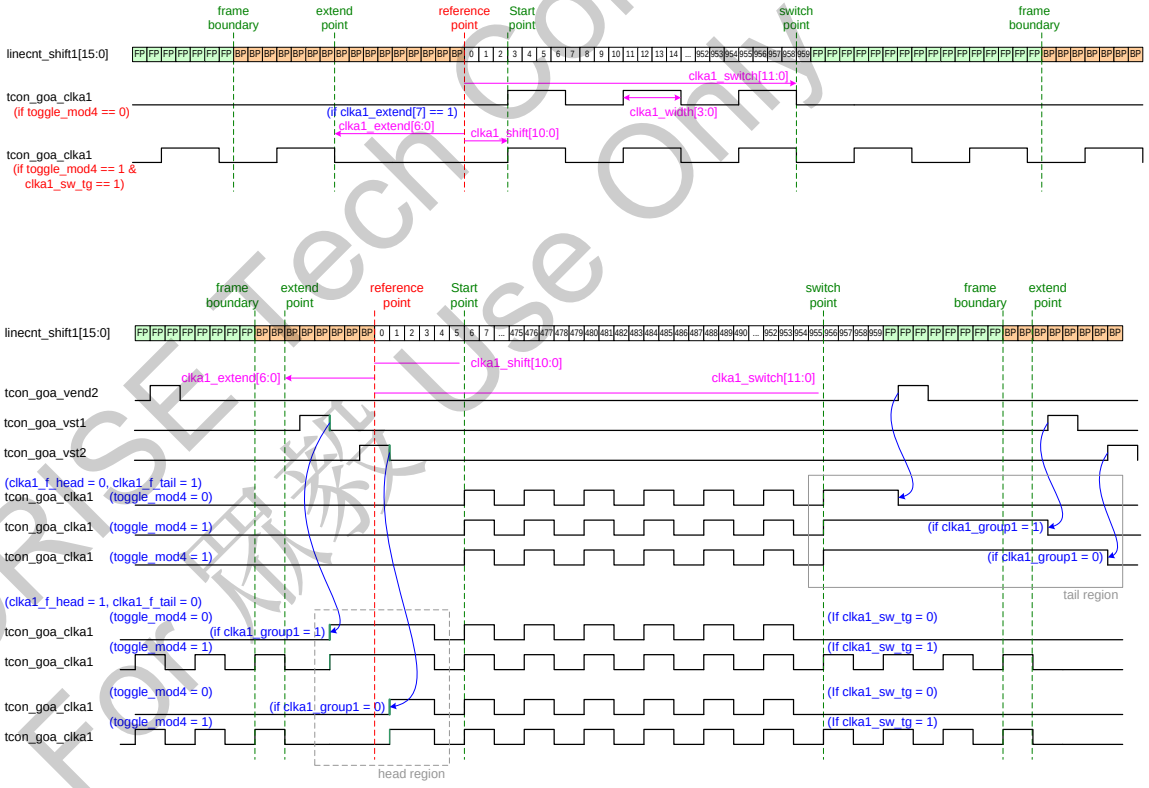
Special Setting Parameters	Description
clka1_sw_tg	Specifies tcon_goa_clka1 behavior in the non-operating area defined as the area after switch point and before start point. 0: tcon_goa_clka1 does not toggle in non-operating area 1: tcon_goa_clka1 continues to toggle in non-operating area, the toggling behaviour may also be controlled by other special setting parameters
clka1_f_head	0: tcon_goa_clka1 stays low in the head area 1: tcon_goa_clka1 goes high in the head area every other frame (decided by clka1_odd_hi)
clka1_f_tail	0: tcon_goa_clka1 stays low in the tail area 1: tcon_goa_clka1 goes high in the tail area every other frame (decided by clka1_odd_hi)
clka1_odd_hi	0: tcon_goa_clka1 goes high in head or tail area during even frames 1: tcon_goa_clka1 goes high in head or tail area during odd frames
clka1_extend[7]	0: tcon_goa_clka1 extend point locates after reference point 1: tcon_goa_clka1 extend point locates before reference point, in BP region
clka1_extend[6:0]	Specifies extend point where tcon_goa_clka1 continues to toggle past line boundary if clka1_sw_tg == 1 and toggle_mod4 == 1 (Note1)



Note1: Please refer to 5.3.69 for related goa signal toggle option

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.52. GOACLKA2(CEA7h~CEADh) GOA CLKA2 Setting

Address	CEh										
Address (SPI/I2C/MDDI)	CEA7h ~ CEADh (0xA8th ~ 0xAEth parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	1	1	0	
0xA8th Parameter	Write/Read		clka2_width[3:0]				clka2_shift[11:8]				10h
0xA9th Parameter	Write/Read		clka2_shift[7:0]								00h
0xAAth Parameter	Write/Read		clka2_ sw_tg	clka2_ odd_hi	clka2_ f_head	clka2_ f_tail	clka2_switch[11:8]				03h
0xABth Parameter	Write/Read		clka2_switch[7:0]								1Eh
0xACth Parameter	Write/Read		clka2_extend[7:0]								00h
0xADth Parameter	Write/Read		clka2_tchop[7:0]								28h
0xAEth Parameter	Write/Read		clka2_tglue[7:0]								00h

Description	These parameters are used to create clock type signal tcon_goa_clka2. Please refer to 5.3.51 for description and function of each tcon_goa_clka2 parameters, and aply the same method to adjust tcon_goa_clka2 signal behavior.
Default	Status: OTP un-programmed → Default Value: Set as default value Status: OTP Programmed → Default Value: Set as OTP value

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5.3.53. GOACLKA3(CEB0h~CEB6h) GOA CLKA3 Setting

Address	CEh										
Address (SPI/I2C/MDDI)	CEB0h ~ CEB6h (0xB1st ~ 0xB7th parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	1	1	0	
0xB1st Parameter	Write/Read		clka3_width[3:0]				clka3_shift[11:8]				10h
0xB2nd Parameter	Write/Read		clka3_shift[7:0]								01h
0xB3rd Parameter	Write/Read		clka3_sw_tg	clka3_odd_hi	clka3_f_head	clka3_f_tail	clka3_switch[11:8]				03h
0xB4th Parameter	Write/Read		clka3_switch[7:0]								1Fh
0xB5th Parameter	Write/Read		clka3_extend[7:0]								00h
0xB6th Parameter	Write/Read		clka3_tchop[7:0]								28h
0xB7th Parameter	Write/Read		clka3_tglue[7:0]								00h

Description	These parameters are used to create clock type signal tcon_goa_clka3. Please refer to 5.3.51 for description and function of each tcon_goa_clka3 parameters, and aply the same method to adjust tcon_goa_clka3 signal behavior.
Default	Status: OTP un-programmed → Default Value: Set as default value Status: OTP Programmed → Default Value: Set as OTP value

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5.3.54. GOACLKA4(CEB7h~CEBDh) GOA CLKA4 Setting

Address	CEh										
Address (SPI/I2C/MDDI)	CEB7h ~ CEBDh (0xB8th ~ 0xBEth parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	1	1	0	
0xB8th Parameter	Write/Read		clka4_width[3:0]				clka4_shift[11:8]				10h
0xB9th Parameter	Write/Read		clka4_shift[7:0]								02h
0xBAth Parameter	Write/Read		clka4_sw_tg	clka4_odd_hi	clka4_f_head	clka4_f_tail	clka4_switch[11:8]				03h
0xBBth Parameter	Write/Read		clka4_switch[7:0]								20h
0xBCth Parameter	Write/Read		clka4_extend[7:0]								00h
0xBDth Parameter	Write/Read		clka4_tchop[7:0]								28h
0xBEth Parameter	Write/Read		clka4_tglue[7:0]								00h

Description	These parameters are used to create clock type signal tcon_goa_clka4. Please refer to 5.3.51 for description and function of each tcon_goa_clka4 parameters, and aply the same method to adjust tcon_goa_clka4 signal behavior.
Default	Status: OTP un-programmed → Default Value: Set as default value Status: OTP Programmed → Default Value: Set as OTP value

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5.3.55. GOACLKB1(CEC0h~CEC6h) GOA CLKB1 Setting

Address	CEh										
Address (SPI/I2C/MDDI)	CEC0h ~ CEC6h (0xC1st ~ 0xC7th parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	1	1	0	
0xC1st Parameter	Write/Read		clkb1_width[3:0]				clkb1_shift[11:8]				38h
0xC2nd Parameter	Write/Read		clkb1_shift[7:0]								02h
0xC3rd Parameter	Write/Read		clkb1_sw_tg	clkb1_odd_hi	clkb1_f_head	clkb1_f_tail	clkb1_switch[11:8]				03h
0xC4th Parameter	Write/Read		clkb1_switch[7:0]								21h
0xC5th Parameter	Write/Read		clkb1_extend[7:0]								00h
0xC6th Parameter	Write/Read		clkb1_tchop[7:0]								18h
0xC7th Parameter	Write/Read		clkb1_tglue[7:0]								10h

Description	These parameters are used to create clock type signal tcon_goa_clkb1. Please refer to 5.3.51 for description and function of each tcon_goa_clkb1 parameters, and aply the same method to adjust tcon_goa_clkb1 signal behavior.
Default	Status: OTP un-programmed → Default Value: Set as default value Status: OTP Programmed → Default Value: Set as OTP value

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5.3.56. GOACLKB2(CEC7h~CECDh) GOA CLKB2 Setting

Address	CEh										
Address (SPI/I2C/MDDI)	CEC7h ~ CECDh (0xC8th ~ 0xCEth parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	1	1	0	
0xC8th Parameter	Write/Read		clkb2_width[3:0]				clkb2_shift[11:8]				38h
0xC9th Parameter	Write/Read		clkb2_shift[7:0]								01h
0xCAth Parameter	Write/Read		clkb2_ sw_tg	clkb2_ odd_hi	clkb2_ f_head	clkb2_ f_tail	clkb2_switch[11:8]				03h
0xCBth Parameter	Write/Read		clkb2_switch[7:0]								22h
0xCCth Parameter	Write/Read		clkb2_extend[7:0]								00h
0xCDth Parameter	Write/Read		clkb2_tchop[7:0]								18h
0xCEth Parameter	Write/Read		clkb2_tglue[7:0]								10h

Description	These parameters are used to create clock type signal tcon_goa_clkb2. Please refer to 5.3.51 for description and function of each tcon_goa_clkb2 parameters, and aply the same method to adjust tcon_goa_clkb2 signal behavior.
Default	Status: OTP un-programmed → Default Value: Set as default value Status: OTP Programmed → Default Value: Set as OTP value

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5.3.57. GOACLKB3(CED0h~CED6h) GOA CLKB3 Setting

Address	CEh										
Address (SPI/I2C/MDDI)	CED0h ~ CED6h (0xD1st ~ 0xD7th parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	1	1	0	
0xD1st Parameter	Write/Read		clkb3_width[3:0]				clkb3_shift[11:8]				30h
0xD2nd Parameter	Write/Read		clkb3_shift[7:0]								01h
0xD3rd Parameter	Write/Read		clkb3_ sw_tg	clkb3_ odd_hi	clkb3_ f_head	clkb3_ f_tail	clkb3_switch[11:8]				03h
0xD4th Parameter	Write/Read		clkb3_switch[7:0]								1Dh
0xD5th Parameter	Write/Read		clkb3_extend[7:0]								00h
0xD6th Parameter	Write/Read		clkb3_tchop[7:0]								18h
0xD7th Parameter	Write/Read		clkb3_tglue[7:0]								10h

Description	These parameters are used to create clock type signal tcon_goa_clkb3. Please refer to 5.3.51 for description and function of each tcon_goa_clkb3 parameters, and aply the same method to adjust tcon_goa_clkb3 signal behavior.
Default	Status: OTP un-programmed → Default Value: Set as default value Status: OTP Programmed → Default Value: Set as OTP value

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5.3.58. GOACLKB4(CED7h~CEDDh) GOA CLKB4 Setting

Address	CEh										
Address (SPI/I2C/MDDI)	CED7h ~ CEDDh (0xD8th ~ 0xDEth parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	1	1	0	
0xD8th Parameter	Write/Read		clkb4_width[3:0]				clkb4_shift[11:8]				30h
0xD9th Parameter	Write/Read		clkb4_shift[7:0]								02h
0xDAth Parameter	Write/Read		clkb4_sw_tg	clkb4_odd_hi	clkb4_f_head	clkb4_f_tail	clkb4_switch[11:8]				03h
0xDBth Parameter	Write/Read		clkb4_switch[7:0]								1Eh
0xDCth Parameter	Write/Read		clkb4_extend[7:0]								00h
0xDDth Parameter	Write/Read		clkb4_tchop[7:0]								18h
0xDEth Parameter	Write/Read		clkb4_tglue[7:0]								10h

Description	These parameters are used to create clock type signal tcon_goa_clkb4. Please refer to 5.3.51 for description and function of each tcon_goa_clkb4 parameters, and aply the same method to adjust tcon_goa_clkb4 signal behavior.
Default	Status: OTP un-programmed → Default Value: Set as default value Status: OTP Programmed → Default Value: Set as OTP value

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5.3.59. GOACLKC1(CF80h~CF86h) GOA CLKC1 Setting

Address	CFh										
Address (SPI/I2C/MDDI)	CF80h ~ CF86h (0x81st ~ 0x87th parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	1	1	1	
0x81st Parameter	Write/Read		clkc1_width[3:0]				clkc1_shift[11:8]				10h
0x82nd Parameter	Write/Read		clkc1_shift[7:0]								02h
0x83rd Parameter	Write/Read		clkc1_ sw_tg	clkc1_ odd_hi	clkc1_ f_head	clkc1_ f_tail	clkc1_switch[11:8]				03h
0x84th Parameter	Write/Read		clkc1_switch[7:0]								20h
0x85th Parameter	Write/Read		clkc1_extend[7:0]								00h
0x86th Parameter	Write/Read		clkc1_tchop[7:0]								28h
0x87th Parameter	Write/Read		clkc1_tglue[7:0]								00h

Description	These parameters are used to create clock type signal tcon_goa_clkc1. Please refer to 5.3.51 for description and function of each tcon_goa_clkc1 parameters, and aply the same method to adjust tcon_goa_clkc1 signal behavior.
Default	Status: OTP un-programmed → Default Value: Set as default value Status: OTP Programmed → Default Value: Set as OTP value

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5.3.60. GOACLKC2(CF87h~CF8Dh) GOA CLKC2 Setting

Address	CFh										
Address (SPI/I2C/MDDI)	CF87h ~ CF8Dh (0x88th ~ 0x8Eth parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	1	1	1	
0x88th Parameter	Write/Read		clkc2_width[3:0]				clkc2_shift[11:8]				10h
0x89th Parameter	Write/Read		clkc2_shift[7:0]								01h
0x8Ath Parameter	Write/Read		clkc2_sw_tg	clkc2_odd_hi	clkc2_f_head	clkc2_f_tail	clkc2_switch[11:8]				03h
0x8Bth Parameter	Write/Read		clkc2_switch[7:0]								1Fh
0x8Cth Parameter	Write/Read		clkc2_extend[7:0]								00h
0x8Dth Parameter	Write/Read		clkc2_tchop[7:0]								28h
0x8Eth Parameter	Write/Read		clkc2_tglue[7:0]								00h

Description	These parameters are used to create clock type signal tcon_goa_clkc2. Please refer to 5.3.51 for description and function of each tcon_goa_clkc2 parameters, and aply the same method to adjust tcon_goa_clkc2 signal behavior.
Default	Status: OTP un-programmed → Default Value: Set as default value Status: OTP Programmed → Default Value: Set as OTP value

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5.3.61. GOACLKC3(CF90h~CF96h) GOA CLKC3 Setting

Address	CFh										
Address (SPI/I2C/MDDI)	CF90h ~ CF96h (0x91st ~ 0x97th parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	1	1	1	
0x91st Parameter	Write/Read		clkc3_width[3:0]				clkc3_shift[11:8]				10h
0x92nd Parameter	Write/Read		clkc3_shift[7:0]								00h
0x93rd Parameter	Write/Read		clkc3_ sw_tg	clkc3_ odd_hi	clkc3_ f_head	clkc3_ f_tail	clkc3_switch[11:8]				03h
0x94th Parameter	Write/Read		clkc3_switch[7:0]								1Eh
0x95th Parameter	Write/Read		clkc3_extend[7:0]								00h
0x96th Parameter	Write/Read		clkc3_tchop[7:0]								28h
0x97th Parameter	Write/Read		clkc3_tglue[7:0]								00h

Description	These parameters are used to create clock type signal tcon_goa_clkc3. Please refer to 5.3.51 for description and function of each tcon_goa_clkc3 parameters, and aply the same method to adjust tcon_goa_clkc3 signal behavior.
Default	Status: OTP un-programmed → Default Value: Set as default value Status: OTP Programmed → Default Value: Set as OTP value

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5.3.62. GOACLKC4(CF97h~CF9Dh) GOA CLKC4 Setting

Address	CFh										
Address (SPI/I2C/MDDI)	CF97h ~ CF9Dh (0x98th ~ 0x9Eth parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	1	1	1	
0x98th Parameter	Write/Read		clkc4_width[3:0]				clkc4_shift[11:8]				18h
0x99th Parameter	Write/Read		clkc4_shift[7:0]								00h
0x9Ath Parameter	Write/Read		clkc4_sw_tg	clkc4_odd_hi	clkc4_f_head	clkc4_f_tail	clkc4_switch[11:8]				03h
0x9Bth Parameter	Write/Read		clkc4_switch[7:0]								1Dh
0x9Cth Parameter	Write/Read		clkc4_extend[7:0]								00h
0x9Dth Parameter	Write/Read		clkc4_tchop[7:0]								28h
0x9Eth Parameter	Write/Read		clkc4_tglue[7:0]								00h

Description	These parameters are used to create clock type signal tcon_goa_clkc4. Please refer to 5.3.51 for description and function of each tcon_goa_clkc4 parameters, and aply the same method to adjust tcon_goa_clkc4 signal behavior.
Default	Status: OTP un-programmed → Default Value: Set as default value Status: OTP Programmed → Default Value: Set as OTP value

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5.3.63. GOACLKD1(CFA0h~CFA6h) GOA CLKD1 Setting

Address	CFh										
Address (SPI/I2C/MDDI)	CFA0h ~ CFA6h (0xA1st ~ 0xA7th parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	1	1	1	
0xA1st Parameter	Write/Read		clkd1_width[3:0]				clkd1_shift[11:8]				30h
0xA2nd Parameter	Write/Read		clkd1_shift[7:0]								02h
0xA3rd Parameter	Write/Read		clkd1_ sw_tg	clkd1_ odd_hi	clkd1_ f_head	clkd1_ f_tail	clkd1_switch[11:8]				03h
0xA4th Parameter	Write/Read		clkd1_switch[7:0]								1Eh
0xA5th Parameter	Write/Read		clkd1_extend[7:0]								00h
0xA6th Parameter	Write/Read		clkd1_tchop[7:0]								18h
0xA7th Parameter	Write/Read		clkd1_tglue[7:0]								10h

Description	These parameters are used to create clock type signal tcon_goa_clkd1. Please refer to 5.3.51 for description and function of each tcon_goa_clkd1 parameters, and aply the same method to adjust tcon_goa_clkd1 signal behavior.
Default	Status: OTP un-programmed → Default Value: Set as default value Status: OTP Programmed → Default Value: Set as OTP value

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5.3.64. GOACLKD2(CFA7h~CFADh) GOA CLKD2 Setting

Address	CFh										
Address (SPI/I2C/MDDI)	CFA7h ~ CFADh (0xA8th ~ 0xAEth parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	1	1	1	
0xA8th Parameter	Write/Read		clkd2_width[3:0]				clkd2_shift[11:8]				30h
0xA9th Parameter	Write/Read		clkd2_shift[7:0]								01h
0xAAth Parameter	Write/Read		clkd2_ sw_tg	clkd2_ odd_hi	clkd2_ f_head	clkd2_ f_tail	clkd2_switch[11:8]				03h
0xABth Parameter	Write/Read		clkd2_switch[7:0]								1Fh
0xACth Parameter	Write/Read		clkd2_extend[7:0]								00h
0xADth Parameter	Write/Read		clkd2_tchop[7:0]								18h
0xAEth Parameter	Write/Read		clkd2_tglue[7:0]								10h

Description	These parameters are used to create clock type signal tcon_goa_clkd2. Please refer to 5.3.51 for description and function of each tcon_goa_clkd2 parameters, and aply the same method to adjust tcon_goa_clkd2 signal behavior.
Default	Status: OTP un-programmed → Default Value: Set as default value Status: OTP Programmed → Default Value: Set as OTP value

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5.3.65. GOACLKD3(CFB0h~CFB6h) GOA CLKD3 Setting

Address	CFh										
Address (SPI/I2C/MDDI)	CFB0h ~ CFB6h (0xB1st ~ 0xB7th parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	1	1	1	
0xB1st Parameter	Write/Read		clkd3_width[3:0]				clkd3_shift[11:8]				38h
0xB2nd Parameter	Write/Read		clkd3_shift[7:0]								01h
0xB3rd Parameter	Write/Read		clkd3_sw_tg	clkd3_odd_hi	clkd3_f_head	clkd3_f_tail	clkd3_switch[11:8]				03h
0xB4th Parameter	Write/Read		clkd3_switch[7:0]								22h
0xB5th Parameter	Write/Read		clkd3_extend[7:0]								00h
0xB6th Parameter	Write/Read		clkd3_tchop[7:0]								18h
0xB7th Parameter	Write/Read		clkd3_tglue[7:0]								10h

Description	These parameters are used to create clock type signal tcon_goa_clkd3. Please refer to 5.3.51 for description and function of each tcon_goa_clkd3 parameters, and aply the same method to adjust tcon_goa_clkd3 signal behavior.
Default	Status: OTP un-programmed → Default Value: Set as default value Status: OTP Programmed → Default Value: Set as OTP value

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5.3.66. GOACLKD4(CFB7h~CFBDh) GOA CLKD4 Setting

Address	CFh										
Address (SPI/I2C/MDDI)	CFB7h ~ CFBDh (0xB8th ~ 0xBEth parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	1	1	1	
0xB8th Parameter	Write/Read		clkd4_width[3:0]				clkd4_shift[11:8]				38h
0xB9th Parameter	Write/Read		clkd4_shift[7:0]								02h
0xBAth Parameter	Write/Read		clkd4_sw_tg	clkd4_odd_hi	clkd4_f_head	clkd4_f_tail	clkd4_switch[11:8]				03h
0xBBth Parameter	Write/Read		clkd4_switch[7:0]								21h
0xBCth Parameter	Write/Read		clkd4_extend[7:0]								00h
0xBDth Parameter	Write/Read		clkd4_tchop[7:0]								18h
0xBEth Parameter	Write/Read		clkd4_tglue[7:0]								10h

Description	These parameters are used to create clock type signal tcon_goa_clkd4. Please refer to 5.3.51 for description and function of each tcon_goa_clkd4 parameters, and aply the same method to adjust tcon_goa_clkd4 signal behavior.
Default	Status: OTP un-programmed → Default Value: Set as default value Status: OTP Programmed → Default Value: Set as OTP value

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5.3.67. GOAECLK(CFC0h~CFC5h) GOA ECLK Setting

Address	CFh										
Address (SPI/I2C/MDDI)	CFC0h ~ CFC5h (0xC1th ~ 0xC6th parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	1	1	1	
0xC1st Parameter	Write/Read		eclk_normal_width[7:0]								01h
0xC2nd Parameter	Write/Read		eclk_partial_width[7:0]								01h
0xC3rd Parameter	Write/Read		all_normal_tchop[7:0]								20h
0xC4th Parameter	Write/Read		all_partial_tchop[7:0]								20h
0xC5th Parameter	Write/Read		eclk1_follow[3:0]				eclk2_follow[3:0]				00h
0xC6th Parameter	Write/Read		eclk3_follow[3:0]				eclk4_follow[3:0]				00h

Description

These parameters are used to create eclk type signal and tcon_goa_eclk1~4

Parameters	Description
eclk_normal_width[7:0]	Determines the half-period of tcon_goa_eclk1~4 signals in normal mode, half-period = eclk_normal_width[7:0] – 1 (unit = frames) (Note 1)
eclk_partial_width[7:0]	Determines the half-period of tcon_goa_eclk1~4 signals in partial mode, half-period = eclk_partial_width[7:0] – 1 (unit = frames) (Note 1)
all_normal_tchop[7:0]	Set the tchop (rising edge delay) time for tcon_goa_eclk1~4 signals in normal mode If panel_mode[2:0] = 3'h1, this parameter will override tchop[7:0] parameters for all other goa signals (vstx, vendx, clkax, clkbx, clkdx)
all_partial_tchop[7:0]	Set the tchop (rising edge delay) time for tcon_goa_eclk1~4 signals in partial mode If panel_mode[2:0] = 3'h1, this parameter will override tchop[7:0] parameters for al other goa signals (vstx, vendx, clkax, clkbx, clkdx)
eclk1_follow[3:0]	If eclk_normal_width[7:0] or eclk_partial_width[7:0] = 0, tcon_goa_clk1 outputs the same waveform as one of the tcon_goa_clkx signals according to eclk1_follow[3:0] selection
eclk2_follow[3:0]	If eclk_normal_width[7:0] or eclk_partial_width[7:0] = 0, tcon_goa_clk2 outputs the same waveform as one of the tcon_goa_clkx signals according to eclk2_follow[3:0] selection
eclk3_follow[3:0]	If eclk_normal_width[7:0] or eclk_partial_width[7:0] = 0, tcon_goa_clk3 outputs the same waveform as one of the tcon_goa_clkx signals according to eclk3_follow[3:0] selection
eclk4_follow[3:0]	If eclk_normal_width[7:0] or eclk_partial_width[7:0] = 0, tcon_goa_clk4 outputs the same waveform as one of the tcon_goa_clkx signals according to eclk4_follow[3:0] selection

Note 1: Except when eclk_width[7:0] or eclk_width[7:0] is set to 0 or 1.

eclkx_follow[3:0]	tcon_goa_eclkx is the same as:
0	tcno_goa_clka1
1	tcno_goa_clka2
2	tcno_goa_clka3
3	tcno_goa_clka4
4	tcno_goa_clkb1
5	tcno_goa_clkb2
6	tcno_goa_clkb3
7	tcno_goa_clkb4
8	tcno_goa_clkc1
9	tcno_goa_clkc2
10	tcno_goa_clkc3
11	tcno_goa_clkc4
12	tcno_goa_clkd1
13	tcno_goa_clkd2
14	tcno_goa_clkd3
15	tcno_goa_clkd4

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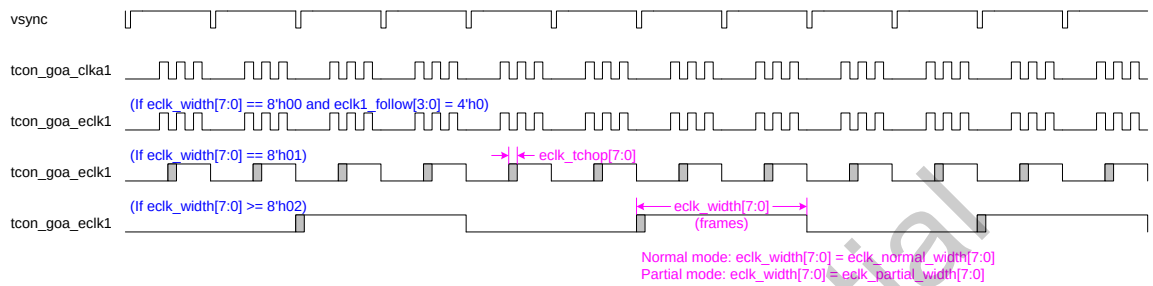
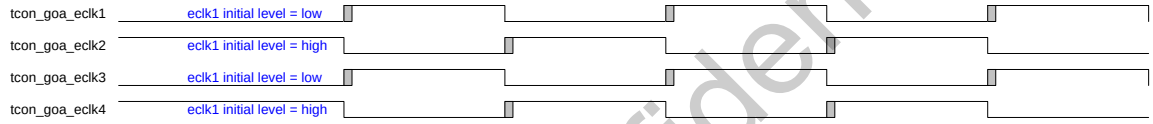


tcon_goa_eclk1~4 have different initial levels after reset. The initial level is not adjustable.



Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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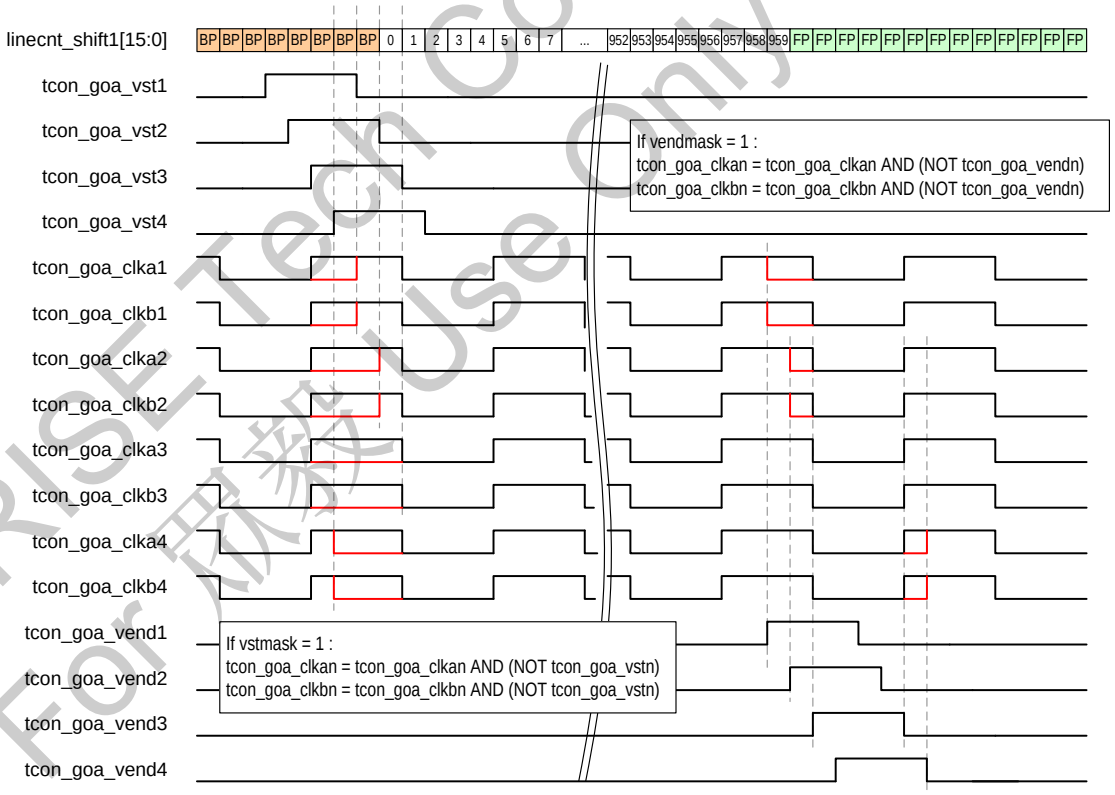
5.3.68. GOAOPT1(CFC6h) GOA Other Options 1

Address	CFh										
Address (SPI/I2C/MDDI)	CFC6h (0xC7th parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	1	1	1	
0xC7th Parameter	Write/Read		0	0	vstmask	vendmask	0	0	dir1_level	dir2_level	01h

Description

There parameters are used to adjust additional goa signal options.

Parameters	Description
vstmask	0: tcon_goa_clka1~a4, tcon_goa_clkb1~b4 output normal clock waveform 1: tcon_goa_clka1~a4, tcon_goa_clkb4~b4 are logically gated with tcon_goa_vst1~4
vendmask	0: tcon_goa_clka1~a4, tcon_goa_clkb1~b4 output normal clock waveform 1: tcon_goa_clka1~a4, tcon_goa_clkb4~b4 are logically gated with tcon_goa_vend1~4
dir1_level	Select DC signal tcon_goa_dir1 output level
dir2_level	Select DC signal tcon_goa_dir2 output level



Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.69. GOATGOPT(CFC7h~CFC9h) GOA Signal Toggle Option Setting

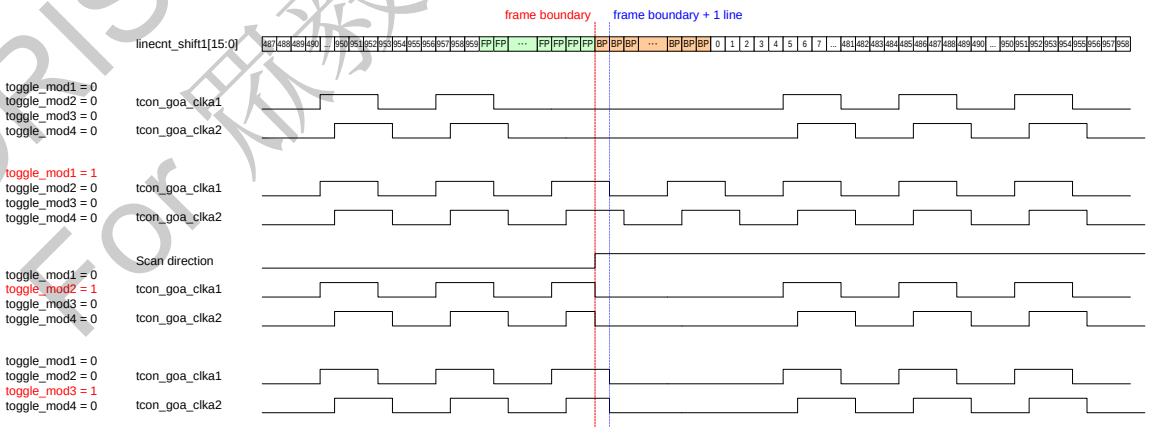
Address	CFh										
Address (SPI/I2C/MDDI)	CFC7h ~ CFC9h (0xC8th ~ 0xCAth parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	0	1	1	1	1	
0xC8th Parameter	Write/Read		gnd_option	0	0	0	toggle_mod1	toggle_mod2	toggle_mod3	toggle_mod4	04h
0xC9th Parameter	Write/Read		duty_block[3:0]				dgpm[3:0]				00h
0xCAth Parameter	Write/Read		gnd_period[7:0]								00h

Description

These parameters are used to define global signal behavior for tcon_goa_vstx, tcon_goa_vendx, and tcon_goa_clkx

Parameters	Description
gnd_option	0: Rising edge of all gate signals goes from VGL to VGH directly 1: Rising edge of all gate signals first pre-charge to GND before reaching VGH. (Note 1)
toggle_mod1	0: toggle_mod1 has no effect 1: all tcon_goa_clkx signals will toggle continuously through display region and porch region
toggle_mod2	0: toggle_mod2 has no effect 1: all tcon_goa_clkx signals will toggle continuously through display region and porch region except when scan direction changes (normal to reverse, or reverse to normal)
toggle_mod3	0: toggle_mod3 has no effect 1: all tcon_goa_clkx signals will toggle continuously until frame boundary + 1 line. The clock signal will stop and restart at the position specified by clkx_shift[11:0]
toggle_mod4	0: toggle_mod4 has no effect 1: all tcon_goa_clkx signals will toggle according to according to behavior specifed by clkx_sw_tg, clkx_f_head, clkx_f_tail, clkx_odd_hi, clkx_extend[7:0] and clkx_switch[11:0]
duty_block[3:0]	Changes tcon_goa_clkx high-low duty ratio while maintaining clk period
dgpm[3:0]	Determines the number of lines GOA signals output VSS before outputting VGH
gnd_period[7:0]	Determines the pre-charge to GND period. (unit = mclk)

tcon_goa_clkx toggling example:



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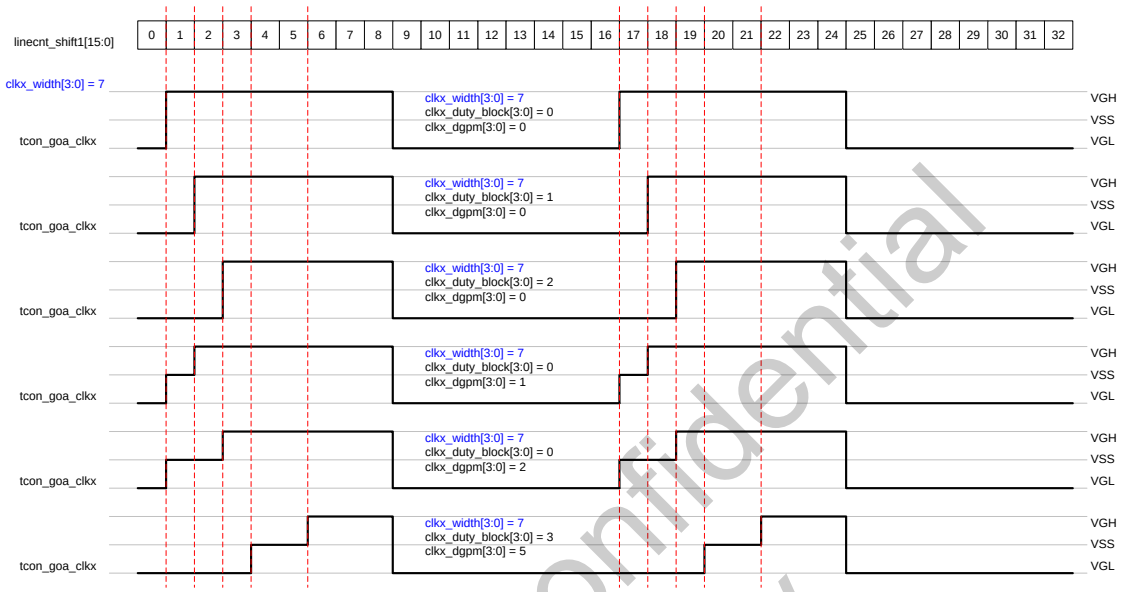
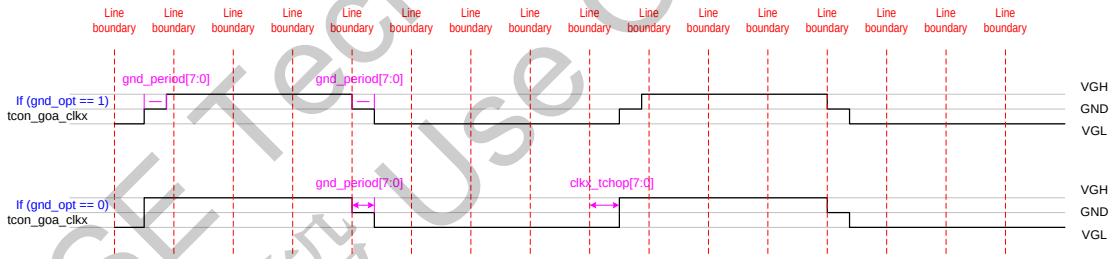
tcon_goa_clkx duty ration and VSS time control example:



gnd_period[7:0]: Define rising and falling edge pre-charge behaviour for tcon_goa_vstx, tcon_goa_vendx, and tcon_goa_clkx.



Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.70. WRID1(D000h) ID1 Setting

Address	D0h										
Address (SPI/I2C/MDDI)	D000h (0x01st parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	1	0	0	0	0	
1st Parameter	Write/Read		ID17	ID16	ID15	ID14	ID13	ID12	ID11	ID10	40h

Description	- This command is used to set ID1
Default	Status: OTP un-programmed → Default Value: Set as default value Status: OTP Programmed → Default Value: Set as OTP value

5.3.71. WRID2(D100h) ID2/ID3 Setting

Address	D1h										
Address (SPI/I2C/MDDI)	D100h ~ D101h (0x01st ~ 0x02nd parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	1	0	0	0	1	
1st Parameter	Write/Read		ID27	ID26	ID25	ID24	ID23	ID22	ID21	ID20	00h
2nd Parameter	Write/Read		ID37	ID36	ID35	ID34	ID33	ID32	ID31	ID30	00h

Description	- This command is used to set ID2/ID3
Default	Status: OTP un-programmed → Default Value: Set as default value Status: OTP Programmed → Default Value: Set as OTP value

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5.3.72. WRDDB(D200h) DDB Setting

Address	D2h										
Address (SPI/I2C/MDDI)	D200h ~ D203h (0x01st ~ 0x04th parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	1	0	0	1	0	
1st Parameter	Write/Read		ID4115	ID4114	ID4113	ID4112	ID4111	ID4110	ID419	ID418	01h
2nd Parameter	Write/Read		ID417	ID416	ID415	ID414	ID413	ID412	ID411	ID410	8Bh
3rd Parameter	Write/Read		ID4215	ID4214	ID4213	ID4212	ID4211	ID4210	ID429	ID428	80h
4th Parameter	Write/Read		ID427	ID426	ID425	ID424	ID423	ID422	ID421	ID420	09h

Description	- This command is used to set A1h/A8h Value
Default	Status: OTP un-programmed → Default Value: Set as default value Status: OTP Programmed → Default Value: Set as OTP value

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5.3.73. EXTCCHK (D300h): EXTC Check

Address	D3h										
Address (SPI/I2C/MDDI)	D300h (0x01st parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	1	0	0	1	1	D3h
1st Parameter	Read	00h	0	0	0	0	0	0	0	reg_extc	00h

Description

- This command is used for check internal EXTC status

Bit	Description	Value
reg_extc	Internal EXTC Value	0：Internal EXTC = 0 1：Internal EXTC = 1

Default

Status	Default Value
OTP un-programmed	No OTP Support
OTP Programmed	No OTP Support

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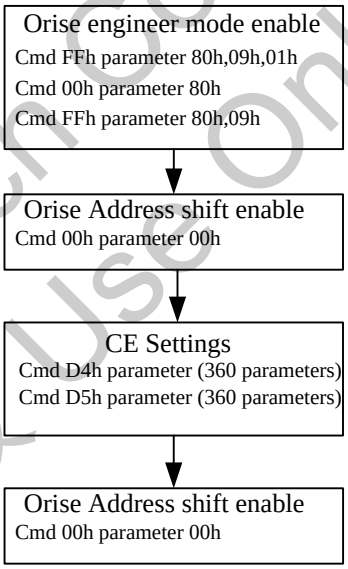
5.3.74. CESET1 (D400h): CE Correction Characteristics Setting 1

Address (MIPI)	D4h										
Address (SPI/I2C/MDDI)	D400h										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	1	0	1	0	0	D4h
1st Parameter	Write/Read		CE1_1[7:0]								00h
2nd Parameter	Write/Read		CE1 _2[7:0]								40h
:	Write/Read		:								
179th Parameter	Write/Read		CE1_179[7:0]								00h
180th Parameter	Write/Read		CE1_180[7:0]								40h
181th Parameter	Write/Read		CE1_181[7:0]								00h
182th Parameter	Write/Read		CE1_182[7:0]								40h
:	Write/Read		:								
359th Parameter	Write/Read		CE1_359[7:0]								00h
360th Parameter	Write/Read		CE1_360[7:0]								40h

Description

- Command D4 totally has 360 parameters, these parameters are produced from the “ORISE Color Enhancement SW Platform—OTM8009A.exe”. After executing this platform, can get the 360 parameters.



- These 360 numbers are the intermediate parameters for the CE algorithm calculation.

Default

Status	Default Value
Power On Sequence	1st、3th ~359th : 0x00；2st、4th ~360th : 0x40
S/W Reset	1st、3th ~359th : 0x00；2st、4th ~360th : 0x40
H/W Reset	1st、3th ~359th : 0x00；2st、4th ~360th : 0x40

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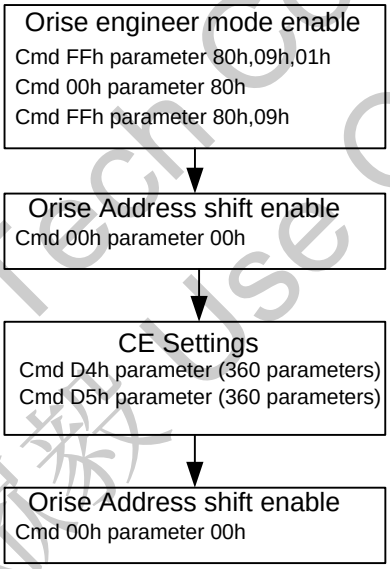
5.3.75. CESET2(D500h): CE Correction Characteristics Setting 2

Address (MIPI)	D5h										
Address (SPI/I2C/MDDI)	D500h										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	1	0	1	0	1	D5h
1st Parameter	Write/Read		CE2_1[7:0]								00h
2nd Parameter	Write/Read		CE2 _2[7:0]								40h
:	Write/Read		:								
179th Parameter	Write/Read		CE2_179[7:0]								00h
180th Parameter	Write/Read		CE2_180[7:0]								40h
181th Parameter	Write/Read		CE2_181[7:0]								00h
182th Parameter	Write/Read		CE2_182[7:0]								40h
:	Write/Read		:								
359th Parameter	Write/Read		CE2_359[7:0]								00h
360th Parameter	Write/Read		CE2_360[7:0]								40h

Description

- Command D5 totally has 360 parameters, these parameters are produced from the “ORISE Color Enhancement SW Platform—OTM8009A.exe”. After executing this platform, can get the 360 parameters.



- These 360 numbers are the intermediate parameters for the CE algorithm calculation.

Default

Status	Default Value
Power On Sequence	1st、3th ~359th : 0x00；2st、4th ~360th : 0x40
S/W Reset	1st、3th ~359th : 0x00；2st、4th ~360th : 0x40
H/W Reset	1st、3th ~359th : 0x00；2st、4th ~360th : 0x40

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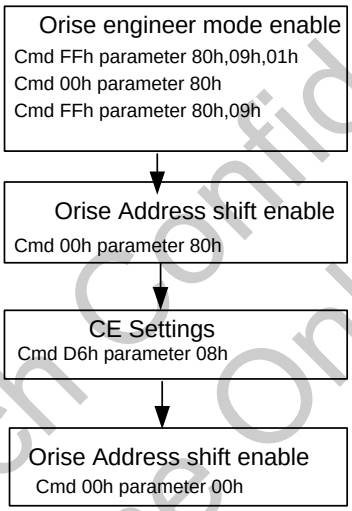
5.3.76. CEEN(D680h): CE Enable

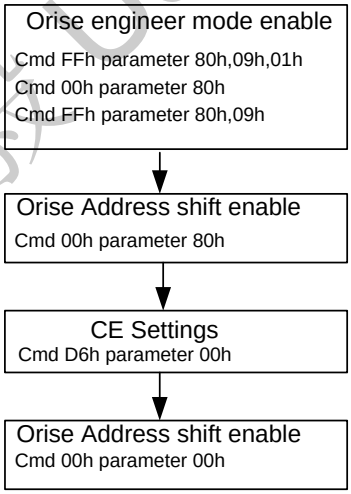
Address (MIPI)	D6h										
Address (SPI/I2C/MDDI)	D680h										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	1	0	1	1	0	
81 Parameter	Write/Read		0	0	0	0	CE_ENA	0	0	0	00h

Description

- CE_ena, 1: enable CE, 0: disable CE
- Enable CE flow



- Disable CE flow



Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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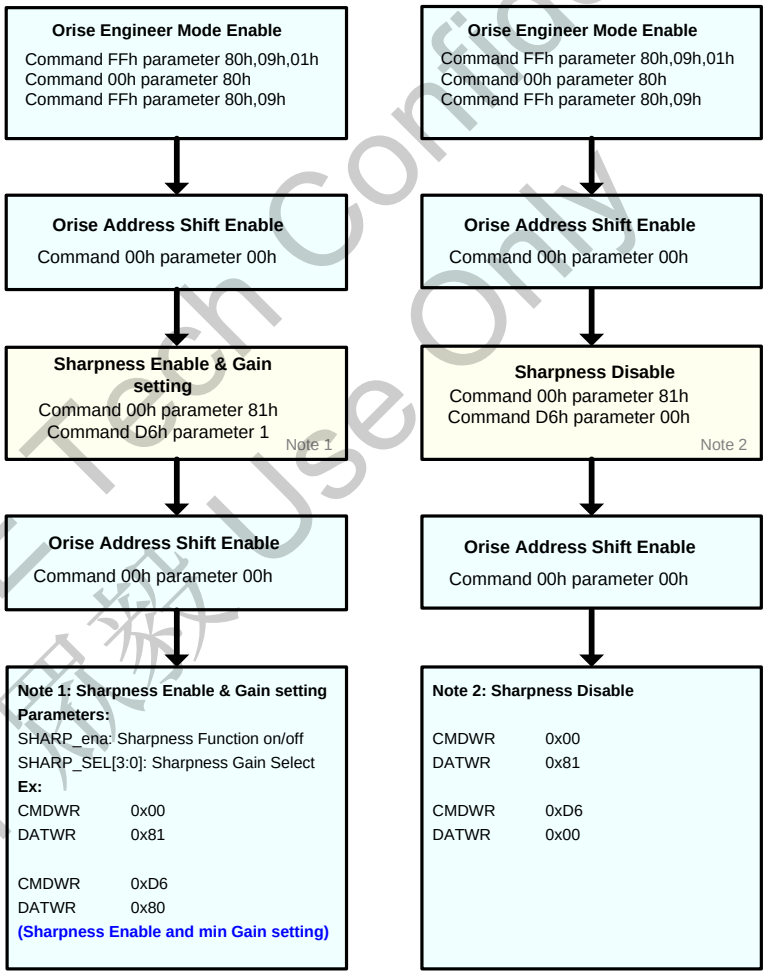
5.3.77. SHARPEN(D681h):Sharpness enable and setting

Address (MIPI)	D6h										
Address (SPI/I2C/MDDI)	D681h										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	1	0	1	1	0	
82 Parameter	Write		SHARP_ena	0	0	0	SHARP_SEL[3:0]				00h

Description

- SHARP_ena, 1: enable Sharpness, 0: disable Sharpness
- SHARP_SEL[3:0]: Sharpness gain value.
- SHARP_SEL=10: Max Sharpness gain value.
- SHARP_SEL=0: min Sharpness gain value.



Default

Status	Default Value
OTP un-programmed	No OTP Support
OTP Programmed	No OTP Support

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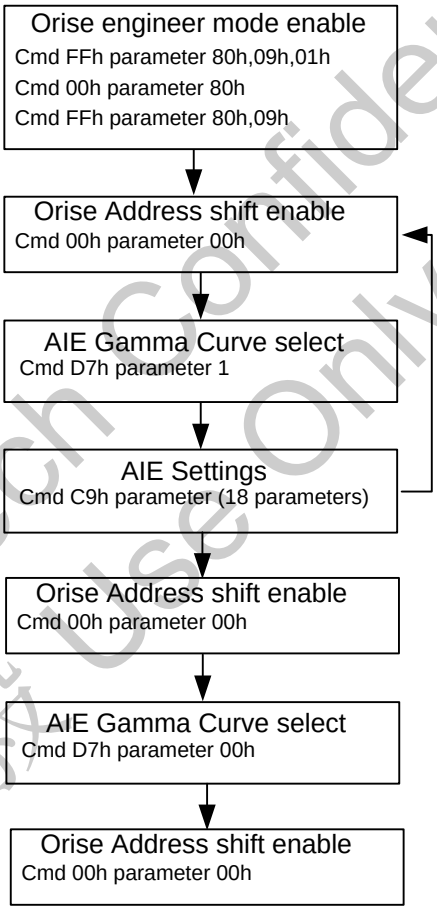
5.3.78. AIEEN(D700h): AIE Enable

Address (MIPI)	D7h										
Address (SPI/I2C/MDDI)	D700h										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	1	0	1	1	1	
Parameter	Write		0	0	0	0	AIE_ENA	AIE_SEL [2:0]			00h

Description

- AIE_ENA, 1: enable AIE, 0: disable AIE
- AIE_SEL [2:0]: AIE_SEL to select one Gamma setting from 8 settings, the gamma need been select by user manual.



Default

Status	Default Value
OTP un-programmed	No OTP Support
OTP Programmed	No OTP Support

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5.3.79. GVDDSET (D800h): GVDD/NGVDD

Address	D8h										
Address (SPI/I2C/MDDI)	D801h ~ D802h (0x01st ~ 0x02th parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	1	1	0	0	0	
1st Parameter	Write/Read		GVDD[7:0]								97h
2nd Parameter	Write/Read		NGVDD[7:0]								97h

Description

- GVDD[7:0] : GVDD Voltage Setting

GVDD[7:0]	GVDD	GVDD[7:0]	GVDD	GVDD[7:0]	GVDD	GVDD[7:0]	GVDD	GVDD[7:0]	GVDD	GVDD[7:0]	GVDD	GVDD[7:0]	GVDD	GVDD[7:0]	GVDD
0	3.1125	20	3.5125	40	3.9125	60	4.3125	80	4.7125	A0	5.1125	C0	5.5125	E0	5.9125
1	3.125	21	3.525	41	3.925	61	4.325	81	4.725	A1	5.125	C1	5.5125	E1	5.925
2	3.1375	22	3.5375	42	3.9375	62	4.3375	82	4.7375	A2	5.1375	C2	5.5125	E2	5.9375
3	3.15	23	3.55	43	3.95	63	4.35	83	4.75	A3	5.15	C3	5.5125	E3	5.95
4	3.1625	24	3.5625	44	3.9625	64	4.3625	84	4.7625	A4	5.1625	C4	5.5125	E4	5.9625
5	3.175	25	3.575	45	3.975	65	4.375	85	4.775	A5	5.175	C5	5.5125	E5	5.975
6	3.1875	26	3.5875	46	3.9875	66	4.3875	86	4.7875	A6	5.1875	C6	5.5125	E6	5.9875
7	3.2	27	3.6	47	4	67	4.4	87	4.8	A7	5.2	C7	5.5125	E7	6
8	3.2125	28	3.6125	48	4.0125	68	4.4125	88	4.8125	A8	5.2125	C8	5.5125	E8	6.0125
9	3.225	29	3.625	49	4.025	69	4.425	89	4.825	A9	5.225	C9	5.5125	E9	6.025
A	3.2375	2A	3.6375	4A	4.0375	6A	4.4375	8A	4.8375	AA	5.2375	CA	5.5125	EA	6.0375
B	3.25	2B	3.65	4B	4.05	6B	4.45	8B	4.85	AB	5.25	CB	5.5125	EB	6.05
C	3.2625	2C	3.6625	4C	4.0625	6C	4.4625	8C	4.8625	AC	5.2625	CC	5.5125	EC	6.0625
D	3.275	2D	3.675	4D	4.075	6D	4.475	8D	4.875	AD	5.275	CD	5.5125	ED	6.075
E	3.2875	2E	3.6875	4E	4.0875	6E	4.4875	8E	4.8875	AE	5.2875	CE	5.5125	EE	6.0875
F	3.3	2F	3.7	4F	4.1	6F	4.5	8F	4.9	AF	5.3	CF	5.5125	EF	6.1
10	3.3125	30	3.7125	50	4.1125	70	4.5125	90	4.9125	B0	5.3125	D0	5.5125	F0	6.1125
11	3.325	31	3.725	51	4.125	71	4.525	91	4.925	B1	5.325	D1	5.5125	F1	6.125
12	3.3375	32	3.7375	52	4.1375	72	4.5375	92	4.9375	B2	5.3375	D2	5.5125	F2	6.1375
13	3.35	33	3.75	53	4.15	73	4.55	93	4.95	B3	5.35	D3	5.5125	F3	6.15
14	3.3625	34	3.7625	54	4.1625	74	4.5625	94	4.9625	B4	5.3625	D4	5.5125	F4	6.1625
15	3.375	35	3.775	55	4.175	75	4.575	95	4.975	B5	5.375	D5	5.5125	F5	6.175
16	3.3875	36	3.7875	56	4.1875	76	4.5875	96	4.9875	B6	5.3875	D6	5.5125	F6	6.1875
17	3.4	37	3.8	57	4.2	77	4.6	97	5	B7	5.4	D7	5.5125	F7	6.2
18	3.4125	38	3.8125	58	4.2125	78	4.6125	98	5.0125	B8	5.4125	D8	5.5125	F8	6.2125
19	3.425	39	3.825	59	4.225	79	4.625	99	5.025	B9	5.425	D9	5.5125	F9	6.225
1A	3.4375	3A	3.8375	5A	4.2375	7A	4.6375	9A	5.0375	BA	5.4375	DA	5.5125	FA	6.2375
1B	3.45	3B	3.85	5B	4.25	7B	4.65	9B	5.05	BB	5.45	DB	5.5125	FB	6.25
1C	3.4625	3C	3.8625	5C	4.2625	7C	4.6625	9C	5.0625	BC	5.4625	DC	5.5125	FC	6.2625
1D	3.475	3D	3.875	5D	4.275	7D	4.675	9D	5.075	BD	5.475	DD	5.5125	FD	6.275
1E	3.4875	3E	3.8875	5E	4.2875	7E	4.6875	9E	5.0875	BE	5.4875	DE	5.5125	FE	6.2875
1F	3.5	3F	3.9	5F	4.3	7F	4.7	9F	5.1	BF	5.5	DF	5.5125	FF	6.3

- NGVDD[7:0] : NGVDD Voltage Setting

NGVDD[7:0]	NGVDD	NGVDD[7:0]	NGVDD	NGVDD[7:0]	NGVDD	NGVDD[7:0]	NGVDD	NGVDD[7:0]	NGVDD	NGVDD[7:0]	NGVDD	NGVDD[7:0]	NGVDD	NGVDD[7:0]	NGVDD
0	-3.1125	20	-3.5125	40	-3.9125	60	-4.3125	80	-4.7125	A0	-5.1125	C0	-5.5125	E0	-5.9125
1	-3.125	21	-3.525	41	-3.925	61	-4.325	81	-4.725	A1	-5.125	C1	-5.525	E1	-5.925
2	-3.1375	22	-3.5375	42	-3.9375	62	-4.3375	82	-4.7375	A2	-5.1375	C2	-5.5375	E2	-5.9375
3	-3.15	23	-3.55	43	-3.95	63	-4.35	83	-4.75	A3	-5.15	C3	-5.55	E3	-5.95
4	-3.1625	24	-3.5625	44	-3.9625	64	-4.3625	84	-4.7625	A4	-5.1625	C4	-5.5625	E4	-5.9625
5	-3.175	25	-3.575	45	-3.975	65	-4.375	85	-4.775	A5	-5.175	C5	-5.575	E5	-5.975
6	-3.1875	26	-3.5875	46	-3.9875	66	-4.3875	86	-4.7875	A6	-5.1875	C6	-5.5875	E6	-5.9875
7	-3.2	27	-3.6	47	-4	67	-4.4	87	-4.8	A7	-5.2	C7	-5.6	E7	-6
8	-3.2125	28	-3.6125	48	-4.0125	68	-4.4125	88	-4.8125	A8	-5.2125	C8	-5.6125	E8	-6.0125
9	-3.225	29	-3.625	49	-4.025	69	-4.425	89	-4.825	A9	-5.225	C9	-5.625	E9	-6.025
A	-3.2375	2A	-3.6375	4A	-4.0375	6A	-4.4375	8A	-4.8375	AA	-5.2375	CA	-5.6375	EA	-6.0375
B	-3.25	2B	-3.65	4B	-4.05	6B	-4.45	8B	-4.85	AB	-5.25	CB	-5.65	EB	-6.05
C	-3.2625	2C	-3.6625	4C	-4.0625	6C	-4.4625	8C	-4.8625	AC	-5.2625	CC	-5.6625	EC	-6.0625
D	-3.275	2D	-3.675	4D	-4.075	6D	-4.475	8D	-4.875	AD	-5.275	CD	-5.675	ED	-6.075
E	-3.2875	2E	-3.6875	4E	-4.0875	6E	-4.4875	8E	-4.8875	AE	-5.2875	CE	-5.6875	EE	-6.0875
F	-3.3	2F	-3.7	4F	-4.1	6F	-4.5	8F	-4.9	AF	-5.3	CF	-5.7	EF	-6.1
10	-3.3125	30	-3.7125	50	-4.1125	70	-4.5125	90	-4.9125	B0	-5.3125	D0	-5.7125	F0	-6.1125
11	-3.325	31	-3.725	51	-4.125	71	-4.525	91	-4.925	B1	-5.325	D1	-5.725	F1	-6.125
12	-3.3375	32	-3.7375	52	-4.1375	72	-4.5375	92	-4.9375	B2	-5.3375	D2	-5.7375	F2	-6.1375
13	-3.35	33	-3.75	53	-4.15	73	-4.55	93	-4.95	B3	-5.35	D3	-5.75	F3	-6.15
14	-3.3625	34	-3.7625	54	-4.1625	74	-4.5625	94	-4.9625	B4	-5.3625	D4	-5.7625	F4	-6.1625
15	-3.375	35	-3.775	55	-4.175	75	-4.575	95	-4.975	B5	-5.375	D5	-5.775	F5	-6.175
16	-3.3875	36	-3.7875	56	-4.1875	76	-4.5875	96	-4.9875	B6	-5.3875	D6	-5.7875	F6	-6.1875
17	-3.4	37	-3.8	57	-4.2	77	-4.6	97	-5	B7	-5.4	D7	-5.8	F7	-6.2
18	-3.4125	38	-3.8125	58	-4.2125	78	-4.6125	98	-5.0125	B8	-5.4125	D8	-5.8125	F8	-6.2125
19	-3.425	39	-3.825	59	-4.225	79	-4.625	99	-5.025	B9	-5.425	D9	-5.825	F9	-6.225
1A	-3.4375	3A	-3.8375	5A	-4.2375	7A	-4.6375	9A	-5.0375	BA	-5.4375	DA	-5.8375	FA	-6.2375
1B	-3.45	3B	-3.85	5B	-4.25	7B	-4.65	9B	-5.05	BB	-5.45	DB	-5.85	FB	-6.25
1C	-3.4625	3C	-3.8625	5C	-4.2625	7C	-4.6625	9C	-5.0625	BC	-5.4625	DC	-5.8625	FC	-6.2625
1D	-3.475	3D	-3.875	5D	-4.275	7D	-4.675	9D	-5.075	BD	-5.475	DD	-5.875	FD	-6.275
1E	-3.4875	3E	-3.8875	5E	-4.2875	7E	-4.6875	9E	-5.0875	BE	-5.4875	DE	-5.8875	FE	-6.2875
1F	-3.5	3F	-3.9	5F	-4.3	7F	-4.7	9F	-5.1	BF	-5.5	DF	-5.9	FF	-6.3

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Default	Status: OTP un-programmed — Default Value: Set as default value Status: OTP programmed — Default Value: Set as OTP value

5.3.80. VCOMDC (D900h): VCOM voltage setting

Address	D9h										
Address (SPI/I2C/MDDI)	D900h										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	0	1	1	0	0	1	
1st Parameter	Write/Read		VCOMDC								39h

Description

- VCOMDC represent the VCOMDC voltage

Setting table please see below.

VCOM[7:0]	VCOM	VCOM[7:0]	VCOM	VCOM[7:0]	VCOM	VCOM[7:0]	VCOM	VCOM[7:0]	VCOM	VCOM[7:0]	VCOM	VCOM[7:0]	VCOM	VCOM[7:0]	VCOM
0	0.0000	20	-0.6875	40	-1.0875	60	-1.4875	80	-1.8875	A0	-2.2875	C0	-2.6875	E0	-3.0875
1	-0.3000	21	-0.7000	41	-1.1000	61	-1.5000	81	-1.9000	A1	-2.3000	C1	-2.7000	E1	-3.1000
2	-0.3125	22	-0.7125	42	-1.1125	62	-1.5125	82	-1.9125	A2	-2.3125	C2	-2.7125	E2	-3.1125
3	-0.3250	23	-0.7250	43	-1.1250	63	-1.5250	83	-1.9250	A3	-2.3250	C3	-2.7250	E3	-3.1250
4	-0.3375	24	-0.7375	44	-1.1375	64	-1.5375	84	-1.9375	A4	-2.3375	C4	-2.7375	E4	-3.1375
5	-0.3500	25	-0.7500	45	-1.1500	65	-1.5500	85	-1.9500	A5	-2.3500	C5	-2.7500	E5	-3.1500
6	-0.3625	26	-0.7625	46	-1.1625	66	-1.5625	86	-1.9625	A6	-2.3625	C6	-2.7625	E6	-3.1625
7	-0.3750	27	-0.7750	47	-1.1750	67	-1.5750	87	-1.9750	A7	-2.3750	C7	-2.7750	E7	-3.1750
8	-0.3875	28	-0.7875	48	-1.1875	68	-1.5875	88	-1.9875	A8	-2.3875	C8	-2.7875	E8	-3.1875
9	-0.4000	29	-0.8000	49	-1.2000	69	-1.6000	89	-2.0000	A9	-2.4000	C9	-2.8000	E9	-3.2000
A	-0.4125	2A	-0.8125	4A	-1.2125	6A	-1.6125	8A	-2.0125	AA	-2.4125	CA	-2.8125	EA	-3.2125
B	-0.4250	2B	-0.8250	4B	-1.2250	6B	-1.6250	8B	-2.0250	AB	-2.4250	CB	-2.8250	EB	-3.2250
C	-0.4375	2C	-0.8375	4C	-1.2375	6C	-1.6375	8C	-2.0375	AC	-2.4375	CC	-2.8375	EC	-3.2375
D	-0.4500	2D	-0.8500	4D	-1.2500	6D	-1.6500	8D	-2.0500	AD	-2.4500	CD	-2.8500	ED	-3.2500
E	-0.4625	2E	-0.8625	4E	-1.2625	6E	-1.6625	8E	-2.0625	AE	-2.4625	CE	-2.8625	EE	-3.2625
F	-0.4750	2F	-0.8750	4F	-1.2750	6F	-1.6750	8F	-2.0750	AF	-2.4750	CF	-2.8750	EF	-3.2750
10	-0.4875	30	-0.8875	50	-1.2875	70	-1.6875	90	-2.0875	B0	-2.4875	D0	-2.8875	F0	-3.2875
11	-0.5000	31	-0.9000	51	-1.3000	71	-1.7000	91	-2.1000	B1	-2.5000	D1	-2.9000	F1	-3.3000
12	-0.5125	32	-0.9125	52	-1.3125	72	-1.7125	92	-2.1125	B2	-2.5125	D2	-2.9125	F2	-3.3125
13	-0.5250	33	-0.9250	53	-1.3250	73	-1.7250	93	-2.1250	B3	-2.5250	D3	-2.9250	F3	-3.3250
14	-0.5375	34	-0.9375	54	-1.3375	74	-1.7375	94	-2.1375	B4	-2.5375	D4	-2.9375	F4	-3.3375
15	-0.5500	35	-0.9500	55	-1.3500	75	-1.7500	95	-2.1500	B5	-2.5500	D5	-2.9500	F5	-3.3500
16	-0.5625	36	-0.9625	56	-1.3625	76	-1.7625	96	-2.1625	B6	-2.5625	D6	-2.9625	F6	-3.3625
17	-0.5750	37	-0.9750	57	-1.3750	77	-1.7750	97	-2.1750	B7	-2.5750	D7	-2.9750	F7	-3.3750
18	-0.5875	38	-0.9875	58	-1.3875	78	-1.7875	98	-2.1875	B8	-2.5875	D8	-2.9875	F8	-3.3875
19	-0.6000	39	-1.0000	59	-1.4000	79	-1.8000	99	-2.2000	B9	-2.6000	D9	-3.0000	F9	-3.4000
1A	-0.6125	3A	-1.0125	5A	-1.4125	7A	-1.8125	9A	-2.2125	BA	-2.6125	DA	-3.0125	FA	-3.4125
1B	-0.6250	3B	-1.0250	5B	-1.4250	7B	-1.8250	9B	-2.2250	BB	-2.6250	DB	-3.0250	FB	-3.4250
1C	-0.6375	3C	-1.0375	5C	-1.4375	7C	-1.8375	9C	-2.2375	BC	-2.6375	DC	-3.0375	FC	-3.4375
1D	-0.6500	3D	-1.0500	5D	-1.4500	7D	-1.8500	9D	-2.2500	BD	-2.6500	DD	-3.0500	FD	-3.4500
1E	-0.6625	3E	-1.0625	5E	-1.4625	7E	-1.8625	9E	-2.2625	BE	-2.6625	DE	-3.0625	FE	-3.4625
1F	-0.6750	3F	-1.0750	5F	-1.4750	7F	-1.8750	9F	-2.2750	BF	-2.6750	DF	-3.0750	FF	-3.4750

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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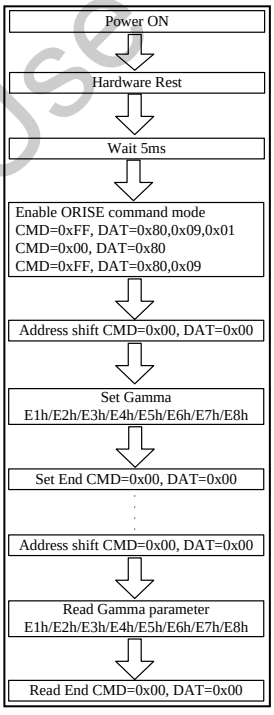
5.3.81. GMCT2.2P (E100h): Gamma Correction Characteristics Setting (2.2 +)

Address	E1h										
Address (SPI/I2C/MDDI)	E100h ~ E10Fh (0x01st ~ 0x10th Parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	1	0	0	0	0	1	E1h
1st Parameter	Write/Read		0	0	G22P1	G22P1	G22P1	G22P1	G22P1	G22P1	09h
2nd Parameter	Write/Read		0	0	G22P2	G22P2	G22P2	G22P2	G22P2	G22P2	11h
3rd Parameter	Write/Read		0	0	G22P3	G22P3	G22P3	G22P3	G22P3	G22P3	17h
4th Parameter	Write/Read		0	0	0	G22P4	G22P4	G22P4	G22P4	G22P4	0Dh
5th Parameter	Write/Read		0	0	0	G22P5	G22P5	G22P5	G22P5	G22P5	06h
6th Parameter	Write/Read		0	0	0	G22P6	G22P6	G22P6	G22P6	G22P6	0Eh
7th Parameter	Write/Read		0	0	0	0	G22P7	G22P7	G22P7	G22P7	0Ah
8th Parameter	Write/Read		0	0	0	0	G22P8	G22P8	G22P8	G22P8	08h
9th Parameter	Write/Read		0	0	0	0	G22P9	G22P9	G22P9	G22P9	05h
10th Parameter	Write/Read		0	0	0	0	G22P10	G22P10	G22P10	G22P10	09h
11st Parameter	Write/Read		0	0	0	G22P11	G22P11	G22P11	G22P11	G22P11	0Dh
12nd Parameter	Write/Read		0	0	0	G22P12	G22P12	G22P12	G22P12	G22P12	07h
13rd Parameter	Write/Read		0	0	0	G22P13	G22P13	G22P13	G22P13	G22P13	0Eh
14th Parameter	Write/Read		0	0	G22P14	G22P14	G22P14	G22P14	G22P14	G22P14	0Eh
15th Parameter	Write/Read		0	0	G22P15	G22P15	G22P15	G22P15	G22P15	G22P15	0Ah
16th Parameter	Write/Read		0	0	G22P16	G22P16	G22P16	G22P16	G22P16	G22P16	05h

Description

- Gamma adjustment for 2.2 positive setting.

Gamma adjustment for 2.2 positive setting	
G22P1	+ Level 0
G22P2	+ Level 1
G22P3	+ Level 2
G22P4	+ Level 4
G22P5	+ Level 6
G22P6	+ Level 13
G22P7	+ Level 20
G22P8	+ Level 27
G22P9	+ Level 36
G22P10	+ Level 43
G22P11	+ Level 50
G22P12	+ Level 57
G22P13	+ Level 59
G22P14	+ Level 61
G22P15	+ Level 62
G22P16	+ Level 63



Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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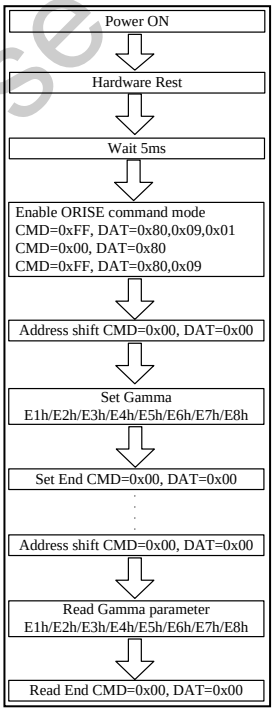
5.3.82. GMCT2.2N (E200h): Gamma Correction Characteristics Setting (2.2 -)

Address	E2h										
Address (SPI/I2C/MDDI)	E200h ~ E20Fh (0x01st ~ 0x10th Parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	1	0	0	0	1	0	E2h
1st Parameter	Write/Read		0	0	G22N1	G22N1	G22N1	G22N 1	G22N 1	G22N 1	09h
2nd Parameter	Write/Read		0	0	G22N2	G22N2	G22N2	G22N2	G22N2	G22N2	11h
3rd Parameter	Write/Read		0	0	G22N3	G22N3	G22N3	G22N3	G22N3	G22N3	17h
4th Parameter	Write/Read		0	0	0	G22N4	G22N4	G22N4	G22N4	G22N4	0Dh
5th Parameter	Write/Read		0	0	0	G22N5	G22N5	G22N5	G22N5	G22N5	06h
6th Parameter	Write/Read		0	0	0	G22N6	G22N6	G22N6	G22N6	G22N6	0Eh
7th Parameter	Write/Read		0	0	0	0	G22N7	G22N7	G22N7	G22N7	0Ah
8th Parameter	Write/Read		0	0	0	0	G22N8	G22N8	G22N8	G22N8	08h
9th Parameter	Write/Read		0	0	0	0	G22N9	G22N9	G22N9	G22N9	05h
10th Parameter	Write/Read		0	0	0	0	G22N 10	G22N 10	G22N 10	G22N 10	09h
11st Parameter	Write/Read		0	0	0	G22N 11	G22N 11	G22N 11	G22N 11	G22N 11	0Dh
12nd Parameter	Write/Read		0	0	0	G22N 12	G22N 12	G22N 12	G22N 12	G22N 12	07h
13rd Parameter	Write/Read		0	0	0	G22N 13	G22N 13	G22N 13	G22N 13	G22N 13	0Eh
14th Parameter	Write/Read		0	0	G22N 14	G22N 14	G22N 14	G22N 14	G22N 14	G22N 14	0Eh
15th Parameter	Write/Read		0	0	G22N 15	G22N 15	G22N 15	G22N 15	G22N 15	G22N 15	0Ah
16th Parameter	Write/Read		0	0	G22N 16	G22N 16	G22N 16	G22N 16	G22N 16	G22N 16	05h

Description

- Gamma adjustment for 2.2 negative setting.

Gamma adjustment for 2.2 negative setting	
G22N1	- Level 0
G22N2	- Level 1
G22N3	- Level 2
G22N4	- Level 4
G22N5	- Level 6
G22N6	- Level 13
G22N7	- Level 20
G22N8	- Level 27
G22N9	- Level 36
G22N10	- Level 43
G22N11	- Level 50
G22N12	- Level 57
G22N13	- Level 59
G22N14	- Level 61
G22N15	- Level 62
G22N16	- Level 63



Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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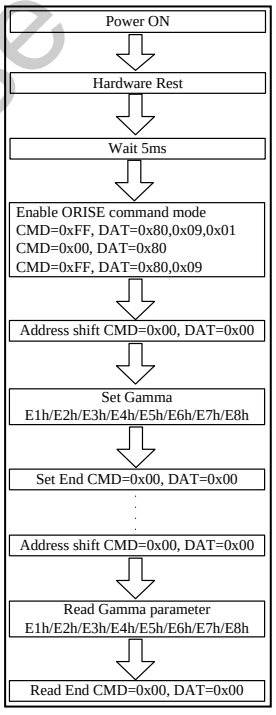
5.3.83. GMCT1.8P (E300h): Gamma Correction Characteristics Setting (1.8 +)

Address	E3h										
Address (SPI/I2C/MDDI)	E300h ~ E30Fh (0x01st ~ 0x10th Parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	1	0	0	0	1	1	E3h
1st Parameter	Write		0	0	G18P1	G18P1	G18P1	G18P1	G18P1	G18P1	09h
2nd Parameter	Write/Read		0	0	G18P2	G18P2	G18P2	G18P2	G18P2	G18P2	11h
3rd Parameter	Write/Read		0	0	G18P3	G18P3	G18P3	G18P3	G18P3	G18P3	17h
4th Parameter	Write/Read		0	0	0	G18P4	G18P4	G18P4	G18P4	G18P4	0Dh
5th Parameter	Write/Read		0	0	0	G18P5	G18P5	G18P5	G18P5	G18P5	06h
6th Parameter	Write/Read		0	0	0	G18P6	G18P6	G18P6	G18P6	G18P6	0Eh
7th Parameter	Write/Read		0	0	0	0	G18P7	G18P7	G18P7	G18P7	0Ah
8th Parameter	Write/Read		0	0	0	0	G18P8	G18P8	G18P8	G18P8	08h
9th Parameter	Write/Read		0	0	0	0	G18P9	G18P9	G18P9	G18P9	05h
10th Parameter	Write/Read		0	0	0	0	G18P10	G18P10	G18P10	G18P10	09h
11st Parameter	Write/Read		0	0	0	G18P11	G18P11	G18P11	G18P11	G18P11	0Dh
12nd Parameter	Write/Read		0	0	0	G18P12	G18P12	G18P12	G18P12	G18P12	07h
13rd Parameter	Write/Read		0	0	0	G18P13	G18P13	G18P13	G18P13	G18P13	0Eh
14th Parameter	Write/Read		0	0	G18P14	G18P14	G18P14	G18P14	G18P14	G18P14	0Eh
15th Parameter	Write/Read		0	0	G18P15	G18P15	G18P15	G18P15	G18P15	G18P15	0Ah
16th Parameter	Write/Read		0	0	G18P16	G18P16	G18P16	G18P16	G18P16	G18P16	05h

Description

- Gamma adjustment for 1.8 positive setting.

Gamma adjustment for 1.8 positive setting	
G18P1	+ Level 0
G18P2	+ Level 1
G18P3	+ Level 2
G18P4	+ Level 4
G18P5	+ Level 6
G18P6	+ Level 13
G18P7	+ Level 20
G18P8	+ Level 27
G18P9	+ Level 36
G18P10	+ Level 43
G18P11	+ Level 50
G18P12	+ Level 57
G18P13	+ Level 59
G18P14	+ Level 61
G18P15	+ Level 62
G18P16	+ Level 63



Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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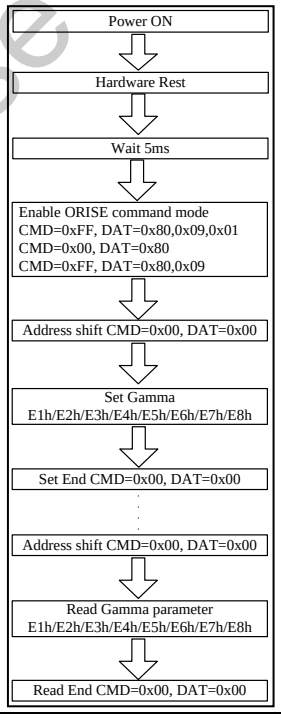
5.3.84. GMCT1.8N (E400h): Gamma Correction Characteristics Setting (1.8 -)

Address	E4h										
Address (SPI/I2C/MDDI)	E400h ~ E40Fh (0x01st ~ 0x10th Parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	1	0	0	1	0	0	E4h
1st Parameter	Write/Read		0	0	G18N1	G18N1	G18N1	G18N1	G18N1	G18N1	09h
2nd Parameter	Write/Read		0	0	G18N2	G18N2	G18N2	G18N2	G18N2	G18N2	11h
3rd Parameter	Write/Read		0	0	G18N3	G18N3	G18N3	G18N3	G18N3	G18N3	17h
4th Parameter	Write/Read		0	0	0	G18N4	G18N4	G18N4	G18N4	G18N4	0Dh
5th Parameter	Write/Read		0	0	0	G18N5	G18N5	G18N5	G18N5	G18N5	06h
6th Parameter	Write/Read		0	0	0	G18N6	G18N6	G18N6	G18N6	G18N6	0Eh
7th Parameter	Write/Read		0	0	0	0	G18N7	G18N7	G18N7	G18N7	0Ah
8th Parameter	Write/Read		0	0	0	0	G18N8	G18N8	G18N8	G18N8	08h
9th Parameter	Write/Read		0	0	0	0	G18N9	G18N9	G18N9	G18N9	05h
10th Parameter	Write/Read		0	0	0	0	G18N 10	G18N 10	G18N 10	G18N 10	09h
11st Parameter	Write/Read		0	0	0	G18N 11	G18N 11	G18N 11	G18N 11	G18N 11	0Dh
12nd Parameter	Write/Read		0	0	0	G18N 12	G18N 12	G18N 12	G18N 12	G18N 12	07h
13rd Parameter	Write/Read		0	0	0	G18N 13	G18N 13	G18N 13	G18N 13	G18N 13	0Eh
14th Parameter	Write/Read		0	0	G18N 14	G18N 14	G18N 14	G18N 14	G18N 14	G18N 14	0Eh
15th Parameter	Write/Read		0	0	G18N 15	G18N 15	G18N 15	G18N 15	G18N 15	G18N 15	0Ah
16th Parameter	Write/Read		0	0	G18N 16	G18N 16	G18N 16	G18N 16	G18N 16	G18N 16	05h

Description

- Gamma adjustment for 1.8 negative setting.

Gamma adjustment for 1.8 negative setting	
G18N1	- Level 0
G18N2	- Level 1
G18N3	- Level 2
G18N4	- Level 4
G18N5	- Level 6
G18N6	- Level 13
G18N7	- Level 20
G18N8	- Level 27
G18N9	- Level 36
G18N10	- Level 43
G18N11	- Level 50
G18N12	- Level 57
G18N13	- Level 59
G18N14	- Level 61
G18N15	- Level 62
G18N16	- Level 63



Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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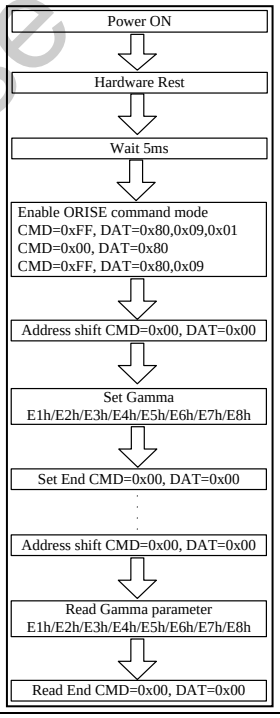
5.3.85. GMCT2.5P (E500h): Gamma Correction Characteristics Setting (2.5 +)

Address	E5h										
Address (SPI/I2C/MDDI)	E500h ~ E50Fh (0x01st ~ 0x10th Parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	1	0	0	1	0	1	E5h
1st Parameter	Write/Read		0	0	G25P1	G25P1	G25P1	G25P1	G25P1	G25P1	09h
2nd Parameter	Write/Read		0	0	G25P2	G25P2	G25P2	G25P2	G25P2	G25P2	11h
3rd Parameter	Write/Read		0	0	G25P3	G25P3	G25P3	G25P3	G25P3	G25P3	17h
4th Parameter	Write/Read		0	0	0	G25P4	G25P4	G25P4	G25P4	G25P4	0Dh
5th Parameter	Write/Read		0	0	0	G25P5	G25P5	G25P5	G25P5	G25P5	06h
6th Parameter	Write/Read		0	0	0	G25P6	G25P6	G25P6	G25P6	G25P6	0Eh
7th Parameter	Write/Read		0	0	0	0	G25P7	G25P7	G25P7	G25P7	0Ah
8th Parameter	Write/Read		0	0	0	0	G25P8	G25P8	G25P8	G25P8	08h
9th Parameter	Write/Read		0	0	0	0	G25P9	G25P9	G25P9	G25P9	05h
10th Parameter	Write/Read		0	0	0	0	G25P10	G25P10	G25P10	G25P10	09h
11st Parameter	Write/Read		0	0	0	G25P11	G25P11	G25P11	G25P11	G25P11	0Dh
12nd Parameter	Write/Read		0	0	0	G25P12	G25P12	G25P12	G25P12	G25P12	07h
13rd Parameter	Write/Read		0	0	0	G25P13	G25P13	G25P13	G25P13	G25P13	0Eh
14th Parameter	Write/Read		0	0	G25P14	G25P14	G25P14	G25P14	G25P14	G25P14	0Eh
15th Parameter	Write/Read		0	0	G25P15	G25P15	G25P15	G25P15	G25P15	G25P15	0Ah
16th Parameter	Write/Read		0	0	G25P16	G25P16	G25P16	G25P16	G25P16	G25P16	05h

Description

- Gamma adjustment for2.5 positive setting.

Gamma adjustment for 2.5 positive setting	
G25P1	+ Level 0
G25P2	+ Level 1
G25P3	+ Level 2
G25P4	+ Level 4
G25P5	+ Level 6
G25P6	+ Level 13
G25P7	+ Level 20
G25P8	+ Level 27
G25P9	+ Level 36
G25P10	+ Level 43
G25P11	+ Level 50
G25P12	+ Level 57
G25P13	+ Level 59
G25P14	+ Level 61
G25P15	+ Level 62
G25P16	+ Level 63



Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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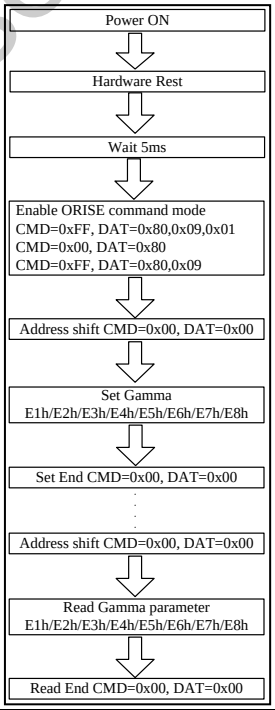
5.3.86. GMCT2.5N (E600h): Gamma Correction Characteristics Setting (2.5 -)

Address	E6h										
Address (SPI/I2C/MDDI)	E600h ~ E60Fh (0x01st ~ 0x10th Parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	1	0	0	1	1	0	E6h
1st Parameter	Write/Read		0	0	G25N1	G25N1	G25N1	G25N1	G25N1	G25N1	09h
2nd Parameter	Write/Read		0	0	G25N2	G25N2	G25N2	G25N2	G25N2	G25N2	11h
3rd Parameter	Write/Read		0	0	G25N3	G25N3	G25N3	G25N3	G25N3	G25N3	17h
4th Parameter	Write/Read		0	0	0	G25N4	G25N4	G25N4	G25N4	G25N4	0Dh
5th Parameter	Write/Read		0	0	0	G25N5	G25N5	G25N5	G25N5	G25N5	06h
6th Parameter	Write/Read		0	0	0	G25N6	G25N6	G25N6	G25N6	G25N6	0Eh
7th Parameter	Write/Read		0	0	0	0	G25N7	G25N7	G25N7	G25N7	0Ah
8th Parameter	Write/Read		0	0	0	0	G25N8	G25N8	G25N8	G25N8	08h
9th Parameter	Write/Read		0	0	0	0	G25N9	G25N9	G25N9	G25N9	05h
10th Parameter	Write/Read		0	0	0	0	G25N 10	G25N 10	G25N 10	G25N 10	09h
11st Parameter	Write/Read		0	0	0	G25N 11	G25N 11	G25N 11	G25N 11	G25N 11	0Dh
12nd Parameter	Write/Read		0	0	0	G25N 12	G25N 12	G25N 12	G25N 12	G25N 12	07h
13rd Parameter	Write/Read		0	0	0	G25N 13	G25N 13	G25N 13	G25N 13	G25N 13	0Eh
14th Parameter	Write/Read		0	0	G25N 14	G25N 14	G25N 14	G25N 14	G25N 14	G25N 14	0Eh
15th Parameter	Write/Read		0	0	G25N 15	G25N 15	G25N 15	G25N 15	G25N 15	G25N 15	0Ah
16th Parameter	Write/Read		0	0	G25N 16	G25N 16	G25N 16	G25N 16	G25N 16	G25N 16	05h

Description

- Gamma adjustment for 2.5 negative setting.

Gamma adjustment for 2.5 negative setting	
G25N1	- Level 0
G25N2	- Level 1
G25N3	- Level 2
G25N4	- Level 4
G25N5	- Level 6
G25N6	- Level 13
G25N7	- Level 20
G25N8	- Level 27
G25N9	- Level 36
G25N10	- Level 43
G25N11	- Level 50
G25N12	- Level 57
G25N13	- Level 59
G25N14	- Level 61
G25N15	- Level 62
G25N16	- Level 63



Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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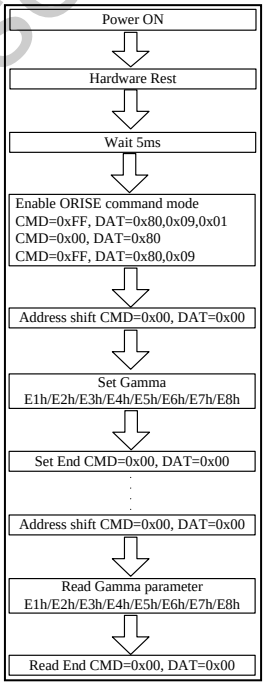
5.3.87. GMCT1.0N (E700h): Gamma Correction Characteristics Setting (1.0 +)

Address	E7h										
Address (SPI/I2C/MDDI)	E700h ~ E70Fh (0x01st ~ 0x10th Parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	1	0	0	1	1	1	E7h
1st Parameter	Write/Read		0	0	G10P1	G10P1	G10P1	G10P1	G10P1	G10P1	09h
2nd Parameter	Write/Read		0	0	G10P2	G10P2	G10P2	G10P2	G10P2	G10P2	11h
3rd Parameter	Write/Read		0	0	G10P3	G10P3	G10P3	G10P3	G10P3	G10P3	17h
4th Parameter	Write/Read		0	0	0	G10P4	G10P4	G10P4	G10P4	G10P4	0Dh
5th Parameter	Write/Read		0	0	0	G10P5	G10P5	G10P5	G10P5	G10P5	06h
6th Parameter	Write/Read		0	0	0	G10P6	G10P6	G10P6	G10P6	G10P6	0Eh
7th Parameter	Write/Read		0	0	0	0	G10P7	G10P7	G10P7	G10P7	0Ah
8th Parameter	Write/Read		0	0	0	0	G10P8	G10P8	G10P8	G10P8	08h
9th Parameter	Write/Read		0	0	0	0	G10P9	G10P9	G10P9	G10P9	05h
10th Parameter	Write/Read		0	0	0	0	G10P 10	G10P 10	G10P 10	G10P 10	09h
11st Parameter	Write/Read		0	0	0	G10P 11	G10P 11	G10P 11	G10P 11	G10P 11	0Dh
12nd Parameter	Write/Read		0	0	0	G10P 12	G10P 12	G10P 12	G10P 12	G10P 12	07h
13rd Parameter	Write/Read		0	0	0	G10P 13	G10P 13	G10P 13	G10P 13	G10P 13	0Eh
14th Parameter	Write/Read		0	0	G10P 14	G10P 14	G10P 14	G10P 14	G10P 14	G10P 14	0Eh
15th Parameter	Write/Read		0	0	G10P 15	G10P 15	G10P 15	G10P 15	G10P 15	G10P 15	0Ah
16th Parameter	Write/Read		0	0	G10P 16	G10P 16	G10P 16	G10P 16	G10P 16	G10P 16	05h

Description

- Gamma adjustment for1.0 positive setting.

Gamma adjustment for 1.0 positive setting	
G10P1	+ Level 0
G10P2	+ Level 1
G10P3	+ Level 2
G10P4	+ Level 4
G10P5	+ Level 6
G10P6	+ Level 13
G10P7	+ Level 20
G10P8	+ Level 27
G10P9	+ Level 36
G10P10	+ Level 43
G10P11	+ Level 50
G10P12	+ Level 57
G10P13	+ Level 59
G10P14	+ Level 61
G10P15	+ Level 62
G10P16	+ Level 63



Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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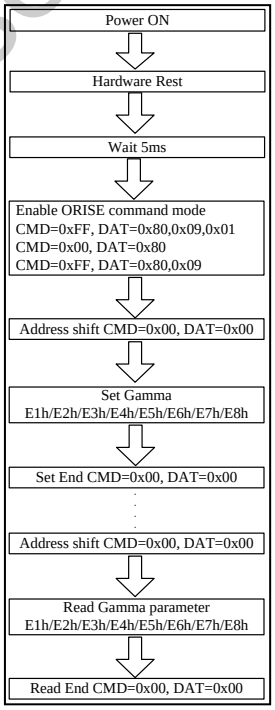
5.3.88. GMCT1.0N (E800h): Gamma Correction Characteristics Setting (1.0 -)

Address	E8h										
Address (SPI/I2C/MDDI)	E800h ~ E80Fh (0x01st ~ 0x10th Parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	1	0	1	0	0	0	E8h
1st Parameter	Write/Read		0	0	G10N1	G10N1	G10N1	G10N1	G10N1	G10N1	09h
2nd Parameter	Write/Read		0	0	G10N2	G10N2	G10N2	G10N2	G10N2	G10N2	11h
3rd Parameter	Write/Read		0	0	G10N3	G10N3	G10N3	G10N3	G10N3	G10N3	17h
4th Parameter	Write/Read		0	0	0	G10N4	G10N4	G10N4	G10N4	G10N4	0Dh
5th Parameter	Write/Read		0	0	0	G10N5	G10N5	G10N5	G10N5	G10N5	06h
6th Parameter	Write/Read		0	0	0	G10N6	G10N6	G10N6	G10N6	G10N6	0Eh
7th Parameter	Write/Read		0	0	0	0	G10N7	G10N7	G10N7	G10N7	0Ah
8th Parameter	Write/Read		0	0	0	0	G10N8	G10N8	G10N8	G10N8	08h
9th Parameter	Write/Read		0	0	0	0	G10N9	G10N9	G10N9	G10N9	05h
10th Parameter	Write/Read		0	0	0	0	G10N 10	G10N 10	G10N 10	G10N 10	09h
11st Parameter	Write/Read		0	0	0	G10N 11	G10N 11	G10N 11	G10N 11	G10N 11	0Dh
12nd Parameter	Write/Read		0	0	0	G10N 12	G10N 12	G10N 12	G10N 12	G10N 12	07h
13rd Parameter	Write/Read		0	0	0	G10N 13	G10N 13	G10N 13	G10N 13	G10N 13	0Eh
14th Parameter	Write/Read		0	0	G10N 14	G10N 14	G10N 14	G10N 14	G10N 14	G10N 14	0Eh
15th Parameter	Write/Read		0	0	G10N 15	G10N 15	G10N 15	G10N 15	G10N 15	G10N 15	0Ah
16th Parameter	Write/Read		0	0	G10N 16	G10N 16	G10N 16	G10N 16	G10N 16	G10N 16	05h

Description

- Gamma adjustment for1.0 negative setting.

Gamma adjustment for 1.0 negative setting	
G10N1	- Level 0
G10N2	- Level 1
G10N3	- Level 2
G10N4	- Level 4
G10N5	- Level 6
G10N6	- Level 13
G10N7	- Level 20
G10N8	- Level 27
G10N9	- Level 36
G10N10	- Level 43
G10N11	- Level 50
G10N12	- Level 57
G10N13	- Level 59
G10N14	- Level 61
G10N15	- Level 62
G10N16	- Level 63



Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.89. NVMIN (EB00h): NV Memory Write Mode

Address	EBh										
Address (SPI/I2C/MDDI)	EB00h(0x01st Parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	1	0	1	0	1	1	EBh
Parameter	Write		0	0	0	0	0	0	0	NVM_PGM	00h

Description

-NVM_PGM: NVM programming Function

NVM_PGM	NVM programming Function
0	Disable
1	Enable

Default

Status	Default Value
OTP un-programmed	No OTP Support
OTP Programmed	No OTP Support

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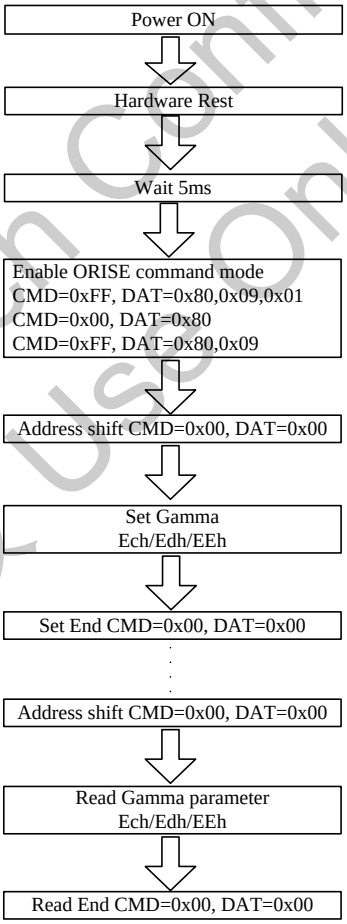
5.3.90. DGAMR (EC00h): Digital Gamma Correction Characteristics Setting (Red):

Address	ECh										
Address (SPI/I2C/MDDI)	EC00h ~ EC20h (0x01st ~ 0x21st Parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	1	0	1	1	0	0	ECh
1st Parameter	Write/Read		DGR2	DGR2	DGR2	DGR2	DGR1	DGR1	DGR1	DGR1	40h
2nd Parameter	Write/Read		DGR4	DGR4	DGR4	DGR4	DGR3	DGR3	DGR3	DGR3	44h
3rd Parameter	Write/Read		DGR6	DGR6	DGR6	DGR6	DGR5	DGR5	DGR5	DGR5	44h
:	Write/Read		:	:							
31st Parameter	Write/Read		DGR62	DGR62	DGR62	DGR62	DGR61	DGR61	DGR61	DGR61	44h
32nd Parameter	Write/Read		DGR64	DGR64	DGR64	DGR64	DGR63	DGR63	DGR63	DGR63	44h
33rd Parameter	Write/Read		0	0	0	0	DGR65	DGR65	DGR65	DGR65	04h

Description

- Command ECh totally has 33 parameters, these parameters are settings for Digital gamma Red curve
- Gamma adjustment for Red setting.



Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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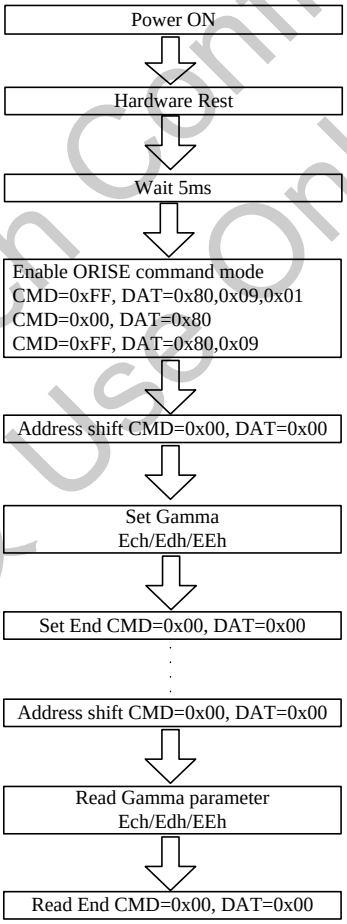
5.3.91. DGAMR (ED00h): Digital Gamma Correction Characteristics Setting (Green):

Address	EDh										
Address (SPI/I2C/MDDI)	ED00h ~ ED20h (0x01st ~0x21st Parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	1	0	1	1	0	1	EDh
1st Parameter	Write/Read		DGG2	DGG2	DGG2	DGG2	DGG1	DGG1	DGG1	DGG1	40h
2nd Parameter	Write/Read		DGG4	DGG4	DGG4	DGG4	DGG3	DGG3	DGG3	DGG3	44h
3rd Parameter	Write/Read		DGG6	DGG6	DGG6	DGG6	DGG5	DGG5	DGG5	DGG5	44h
:	Write/Read		:	:							
31st Parameter	Write/Read		DGG62	DGG62	DGG62	DGG62	DGG29	DGG16	DGG61	DGG61	44h
32nd Parameter	Write/Read		DGG64	DGG64	DGG64	DGG64	DGG63	DGG63	DGG63	DGG63	44h
33rd Parameter	Write/Read		0	0	0	0	DGG65	DGG65	DGG65	DGG65	04h

Description

- Command EDh totally has 33 parameters, these parameters are settings for Digital gamma Green curve
- Gamma adjustment for Green setting.



Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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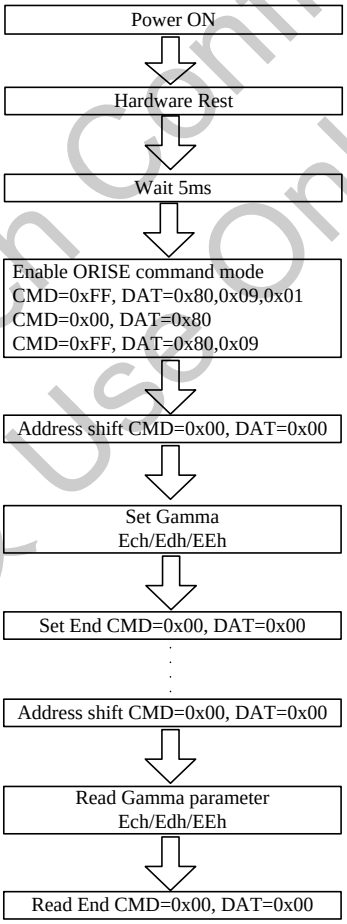
5.3.92. DGAMB (EE00h): Digital Gamma Correction Characteristics Setting (Blue):

Address	EEh										
Address (SPI/I2C/MDDI)	EE00h ~ EE20h (0x01st~0x21st Parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	1	0	1	1	0	1	EDh
1st Parameter	Write/Read		DGB2	DGB2	DGB2	DGB2	DGB1	DGB1	DGB1	DGB1	40h
2nd Parameter	Write/Read		DGB4	DGB4	DGB4	DGB4	DGB3	DGB3	DGB3	DGB3	44h
3rd Parameter	Write/Read		DGB6	DGB6	DGB6	DGB6	DGB5	DGB5	DGB5	DGB5	44h
:	Write/Read		:	:							
31st Parameter	31st Parameter		DGB62	DGB62	DGB62	DGB62	DGB61	DGB61	DGB61	DGB61	44h
32nd Parameter	32nd Parameter		DGB64	DGB64	DGB64	DGB64	DGB63	DGB63	DGB63	DGB63	44h
33rd Parameter	33rd Parameter		0	0	0	0	DGB65	DGB65	DGB65	DGB65	04h

Description

- Command EEh totally has 33 parameters, these parameters are settings for Digital gamma Blue curve
- Gamma adjustment for Blue setting.



Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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5.3.93. PRG_FLAG (F101h): OTP Program Flag Check

Address	F1h										
Address (SPI/I2C/MDDI)	F101h ~ F103h (0x02nd ~0x04th Parameter)										
Inst. / Para.	Write/Read	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Default
Instruction	Write	00h	1	1	1	1	0	0	0	1	F1h
2nd Parameter	Read		rd0_otp_flag[3:0]				rd1_otp_flag[3:0]				00h
3rd Parameter	Read		rd2_otp_flag[3:0]				rd8_otp_flag[3:0]				00h
4th Parameter	Read		rd9_otp_flag[3:0]				0	0	0	0	00h

Description

- This command is used to ID1, ID2/ID3, DDB, GVDD/NGVDD, VCOM

	Value	Bias Current Selection
rd0_otp_flag[3:0] rd1_otp_flag[3:0] rd2_otp_flag[3:0] rd8_otp_flag[3:0] rd9_otp_flag[3:0]	4'h0	OTP has been programed 0 time
	4'h1	OTP has been programed 1 time
	4'h3	OTP has been programed 2 time
	4'h7	OTP has been programed 3 time
	4'hf	OTP has been programed 4 time

Default

Status	Default Value
OTP un-programmed	Set as default value
OTP Programmed	Set as OTP value

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6. FUNCTION DESCRIPTIONS

6.1. Interface type selection

The MPU interfaces of OTM8009A support high speed serial interfaces, including MIPI, MDDI, and 8/16/24-bit 80-system Interface, RGB 16/18/24 bit Interface.SPI/I2C series interface, which can be set by the IM[3:0] pins. The MPU interface can set instructions and access RAM. Table 6-1 depicts the interface corresponding to IM[3:0] pins .

Table 6-1

External Pad Set				Interface format
IM3	IM2	IM1	IM0	
X	0	0	0	80-series 8-bit MPU interface
X	0	0	1	80-series 16-bit MPU interface
X	0	1	0	80-series 24-bit MPU interface
0	0	1	1	RGB + SPI (SCL Rising Trigger)
1	0	1	1	RGB + SPI (SCL Falling Trigger)
X	1	0	0	RGB + I2C
X	1	0	1	MIPI-DSI
0	1	1	0	MDDI + SPI (SCL Rising Trigger)
1	1	1	0	MDDI + SPI (SCL Falling Trigger)
X	1	1	1	MDDI + I2C

Note: X=Don't Care

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6.2. MIPI-DSI interface

6.2.1. General description

The communication can be separated 2 different levels between the MCU and the display module:

- Interface Level : Low level communication
- Packet level : High level communication

6.2.2. Interface level communication

6.2.2.1. General

The display module uses data and clock lane differential pairs for DSI . Both clock lane and data lane0 can be driven Low Power (LP) or High Speed (HS) mode. Data lane1 and Data lane2 can be driven High Speed mode only.

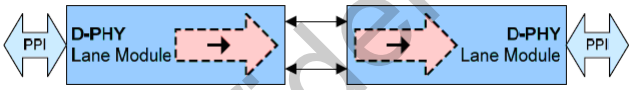
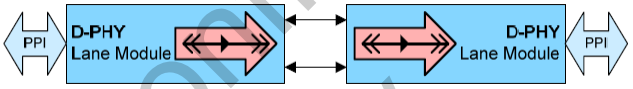
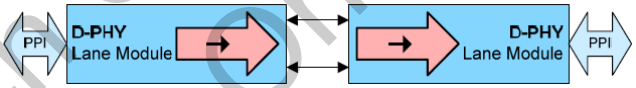
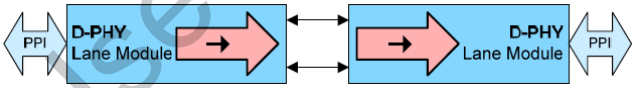
	Lane support mode	MPU(Host) OTM8009A(Slave)
Clock Lane	Unidirectional lane ★High-Speed Clock only ★Simplified Escape Mode (ULPS Only)	
Data lane0	Bi-directional lane ★Forward high-speed only ★Bi-directional Escape Mode ★Bi-direction LPDT	
Data lane1	Unidirectional lane ★Forward high-speed only ★Simplified Escape Mode (ULPS Only)	
Data lane2	Unidirectional lane ★Forward high-speed only ★Simplified Escape Mode (ULPS Only)	

Table 6.2.2.1.1. Lane types and support mode

Low Power mode means that each line of the differential pair is used in single end mode and a differential receiver is disable (A termination resistor of the receiver is disable) and it can be driven into a low power mode.

High Speed mode means that differential pairs (The termination resistor of the receiver is enable) are not used in the single end mode.

There are used different modes and protocols in each mode when there are wanted to transfer information from the MCU to the display module and vice versa.

The State Codes of the High Speed (HS) and Low Power (LP) lane pair are defined below.

Lane Pair State Code	Line DC Voltage Levels		High Speed (HS)	Low-Power (LP)	
	Dn+ Line	Dn- Line	Burst Mode	Control Mode	Escape Mode
HS-0	Low (HS)	High (HS)	Differential-0	Note 1	Note 1
HS-1	High (HS)	Low (HS)	Differential-1	Note 1	Note 1
LP-00	Low (LP)	Low (LP)	Not Defined	Bridge	Space
LP-01	Low (LP)	High (LP)	Not Defined	HS-Request	Mark-0
LP-10	High (LP)	Low (LP)	Not Defined	LP-Request	Mark-1
LP-11	High (LP)	High (LP)	Not Defined	Stop	Note 2

Table 6.2.2.1.2. High Speed and Low-Power Lane Pair State Descriptions

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6.2.2.2. DSI-CLK lanes

DSI-CLK+/- lanes can be driven into three different power modes: Low Power Mode (LPM LP-11), Ultra Low Power Mode (ULPM) or High Speed Clock Mode (HSCM).

Clock lanes are in a single end mode (LP = Low Power) when there is entering or leaving Low Power Mode(LPM) or Ultra Low Power Mode (ULPM).

Clock lanes are in the single end mode (LP = Low Power) when there is entering in or leaving out High Speed Clock Mode (HSCM).

These entering and leaving protocols are using clock lanes in the single end mode to generate an entering or leaving sequences.

The principal flow chart of the different clock lanes power modes is illustrated below.

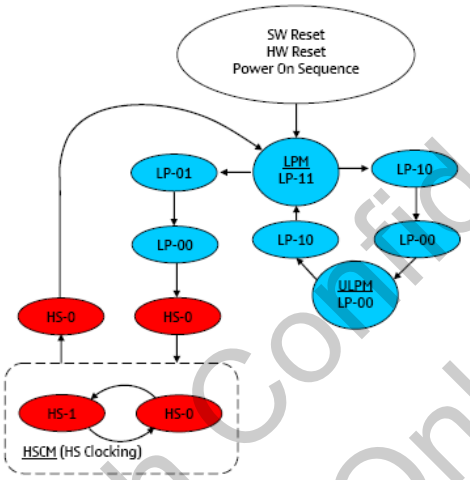

Figure 6.6.2.2.1. Clock Lanes Power Modes

Notes:

1. Low-Power Receivers (LP-Rx) of the lane pair are checking the LP-00 state code, when the Lane Pair is in the High Speed (HS) mode.

2. If Low-Power Receivers (LP-Rx) of the lane pair recognizes LP-11 state code, the lane pair returns to LP-11 of the Control Mode.

Low Power Mode (LPM)

DSI-CLK+/- lanes can be driven to the Low Power Mode (LPM), when DSI-CLK lanes are entering LP-11 State Code, in three different ways:

1) After SW Reset, HW Reset or Power On Sequence =>LP-11

2) After DSI-CLK+/- lanes are leaving Ultra Low Power Mode (ULPM, LP-00 State Code) =>LP-10 =>LP-11 (LPM). This sequence is illustrated below.

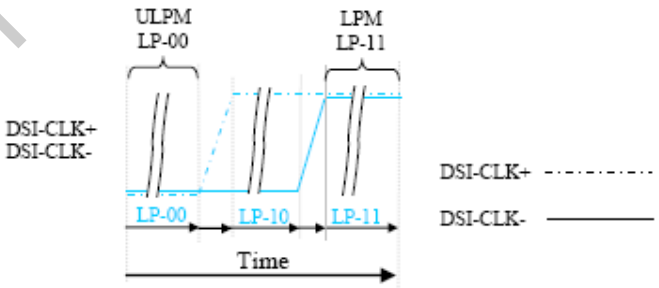

Figure 6.6.2.2.2. From ULPM to LPM

3) After DSI-CLK+/- lanes are leaving High Speed Clock Mode (HSCM, HS-0 or HS-1 State Code) =>HS-0 =>LP-11 (LPM). This sequence is illustrated below.

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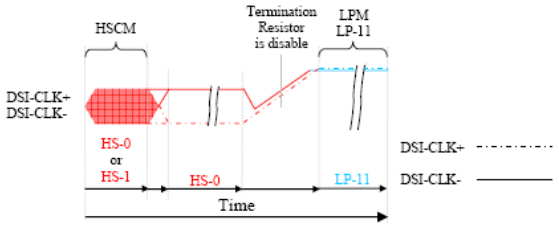

Figure 6.6.2.2.3. From HSCM to LPM

All three mode changes are illustrated a flow chart below.

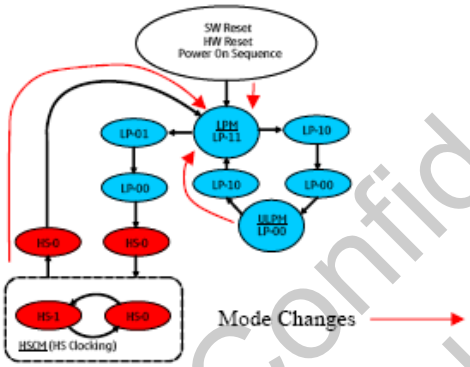

Figure 6.6.2.2.4. All three mode changes to LPM

Ultra Low Power Mode (ULPM)

DSI-CLK+/- lanes can be driven to the High Speed Clock Mode (HSCM), when DSI-CLK lanes are starting to work between HS-0 and HS-1 State Codes.

The only entering possibility is from the Low Power Mode (LPM, LP-11 State Code) =>LP-01 =>LP-00 =>HS-0 =>HS-0/1 (HSCM). This sequence is illustrated below.

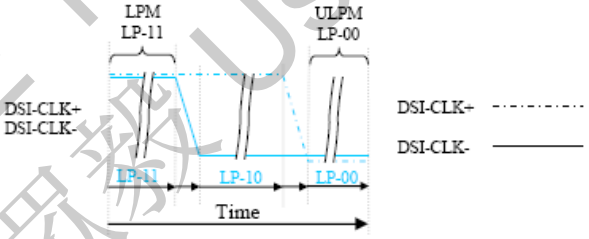

Figure 6.6.2.2.5. From LPM to UPLM

The mode change is also illustrated below:

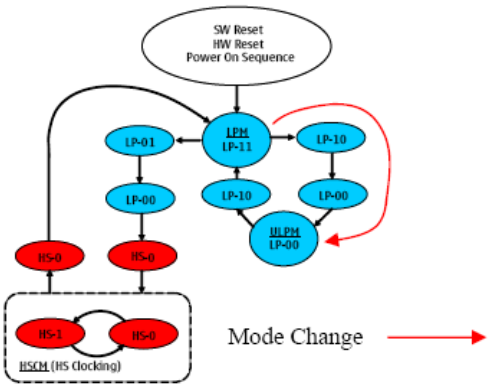

Figure 6.6.2.2.6. The mode change from LPM to UPLM

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High-speed Clock Mode (HSCM)

DSI-CLK+/- lanes can be driven to the High Speed Clock Mode (HSCM), when DSI-CLK lanes are starting to work between HS-0 and HS-1 State Codes.

The only entering possibility is from the Low Power Mode (LPM, LP-11 State Code) =>LP-01 =>LP-00 =>HS-0 =>HS-0/1 (HSCM). This sequence is illustrated below.

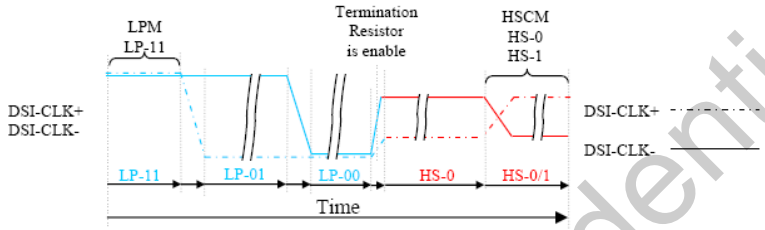

Figure 6.6.2.2.7. From LPM to HSCM

The mode change is also illustrated below:

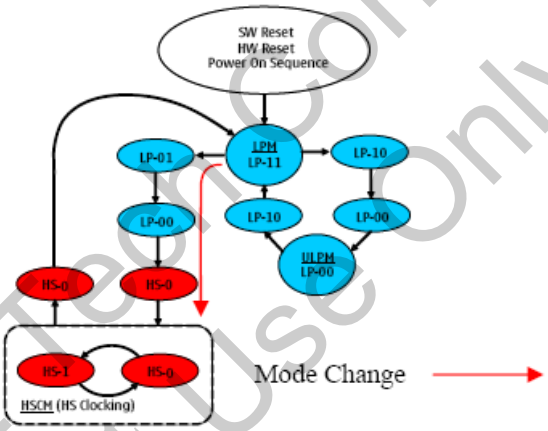

Figure 6.2.2.2.8. Mode change from LPM to HSCM

The high speed clock (DSI-CLK+/-) is started before high speed data is sent via DSI-Dn+/- lanes. The high speed clock continues clocking after the high speed data sending has been stopped

The burst of the high speed clock consists of:

- Even number of transitions
- Start state is HS-0
- End state is HS-0

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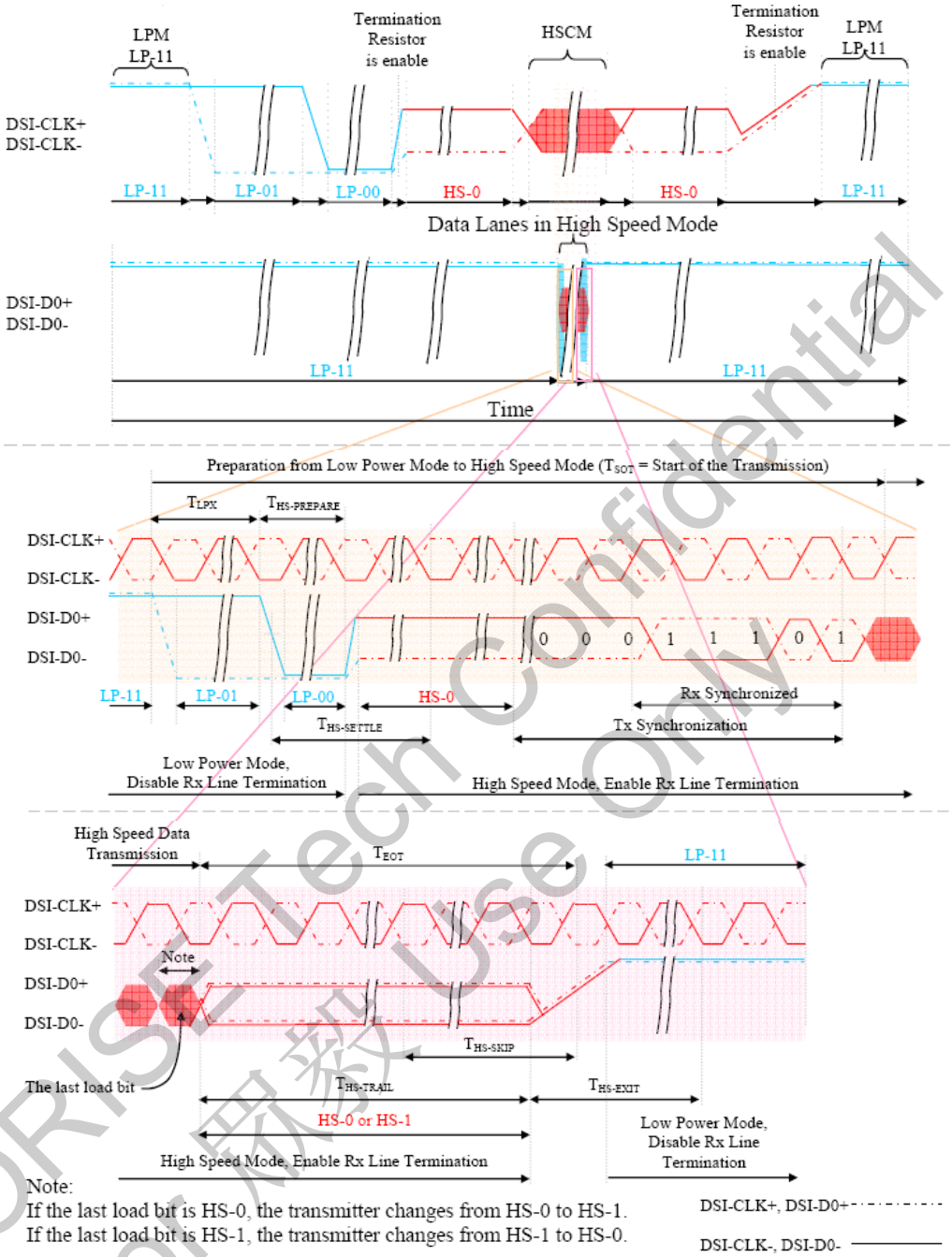

Figure 6.2.2.2.9. High speed clock burst

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6.2.3. DSI data lanes

6.2.3.1. General

DSI-Dn+/- Data Lanes can be driven in different modes which are:

- Escape Mode (only support DSI_D0 data lane pair)
- High-Speed Data Transmission (support all data lane pairs)
- Bus Turnaround Request (only support DSI_D0 data lane pair)

These modes and their entering codes are defined on the following table.

Mode	Entering Mode Sequence	Leaving Mode Sequence
Escape Mode	LP-11 =>LP-10 =>LP-00 =>LP-01 =>LP-00	LP-00 =>LP-10 =>LP-11 (Mark-1)
High-Speed Data Transmission	LP-11 =>LP-01 =>LP-00 =>HS-0	(HS-0 or HS-1) =>LP-11
Bus Turnaround Request	LP-11 =>LP-10 =>LP-00 =>LP-10 =>LP-00	High-Z, Note

Table 6.2.3.1.1. Entering and leaving sequences

6.2.3.2. Escape modes

Escape mode is a special mode of operation for Data Lanes using Low-Power states. With this mode some additional functionality becomes available. Escape mode operation shall be supported in the Forward direction and Reverse direction.

The basic sequence of the Escape Mode is as follow

- Start: LP-11
- Escape Mode Entry : LP-11 =>LP-10 =>LP-00 =>LP-01 =>LP-00
- Escape Command , which is coded, when one of the data lanes is changing from low-to-high-to-low then this changed data lane is presenting a value of the current data bit.
- A payload stream if it is needed
- Exit Escape (Mark-1) LP-00 =>LP-10 =>LP-11
- End: LP-11

For Data Lane0, once Escape mode is entered, the transmitter shall send an 8-bit entry command to indicate the requested action.

All currently available Escape mode commands and actions are list below.

- Send or receive “Low-Power Data Transmission” (LPDT)
- Drive data lanes to “Ultra-Low Power State” (ULPS)
- Indicate “Remote Application Reset” (RAR), which is resetting the display module (same as S/W Reset function)
- Indicate “Tearing Effect” (TEE), which is used for a TE line event from the display module to the MCU,
- Indicate “Acknowledge” (ACK), which is used for a non-error event from the display module to the MCU.

The Stop state shall be used to exit Escape mode and cannot occur during Escape mode operation because of the Spaced-One-Hot encoding. Stop state immediately returns the Lane to Control mode. If the entry command doesn’t match a supported command, that particular Escape mode action shall be ignored and the receive side waits until the transmit side returns to the Stop state.

For Data Lane1 and 2, only support ULPS Escape mode commands.

- Drive data lanes to “Ultra-Low Power State” (ULPS)

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The basic construction is illustrated below:

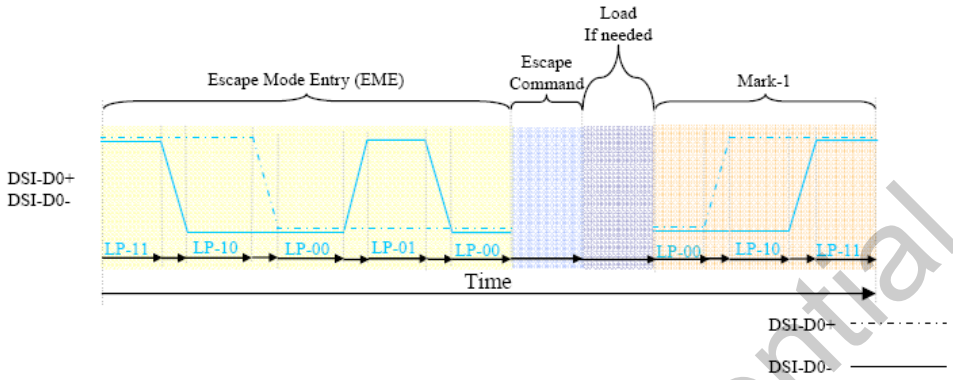

Figure 6.2.3.2.1. General Escape mode sequence

The number of the different Escape Commands is eight. These eight different Escape Commands can be divided 2 different groups: Mode or Trigger.

Escape command groups are defined below.

Escape Command	Command Type Mode/Trigger	Entry Command Pattern (First Bit => Last Bit Transmitted)
Low-Power Data Transmission	Mode	1110 0001bin
Ultra-Low Power Mode	Mode	0001 1110bin
Remote Application Reset	Trigger	0110 0010 bin
Tearing Effect	Trigger	0101 1101 bin
Acknowledge	Trigger	0010 0001 bin

Table 6.2.3.2.1. Escape commands

The MCU is informing to the display module that it is controlling data lanes (DSI-D0+/-) with the mode e.g. The MCU can inform to the display module that it can put data lanes in the low power mode.

The MCU is waiting from the display module event information, which has been set by the MCU, with the trigger e.g. when the display module reaches a new V-synch, the display module sent to the MCU a TE trigger (TEE), if the MCU has been requested it.

Low-Power Data Transmission (LPDT)

The MCU can send data to the display module in Low-Power Data Transmission (LPDT) mode when data lanes are entering in Escape Mode and Low-Power Data Transmission (LPDT) command has been sent to the display module. The display module is also using the same sequence when it is sending data to the MCU.

The Low Power Data Transmission (LPDT) is using a following sequence:

- Start: LP-11
- Escape Mode Entry : LP-11 =>LP-10 =>LP-00 =>LP-01 =>LP-00
- Low-Power Data Transmission (LPDT) command in Escape Mode: 1110 0001 (First to Last bit)
- Payload (Data):
  - One or more bytes
  - Data lanes are in pause mode when data lanes are stopped (Both lanes are low) between bytes
- Mark-1: LP-00 =>LP-10 =>LP-11
- End: LP-11

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This sequence is illustrated for reference purposes below:

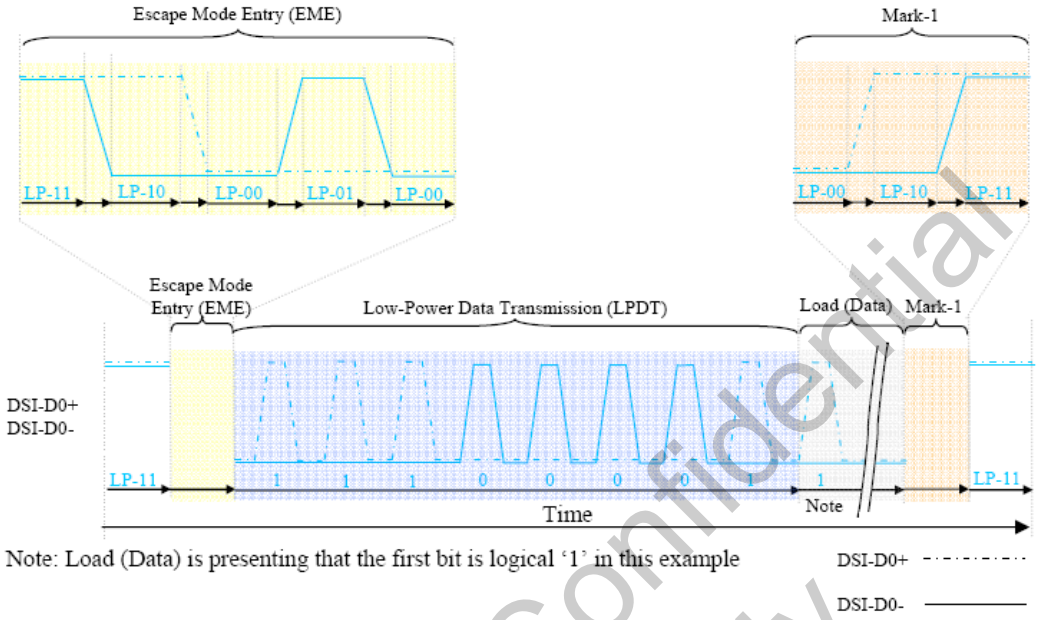

Figure 6.2.3.2.2. Low-power data transmission

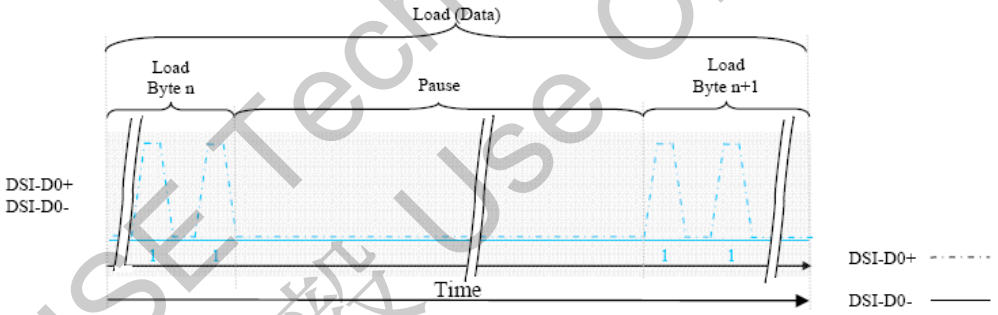

Figure 6.2.3.2.3. Pause (example)

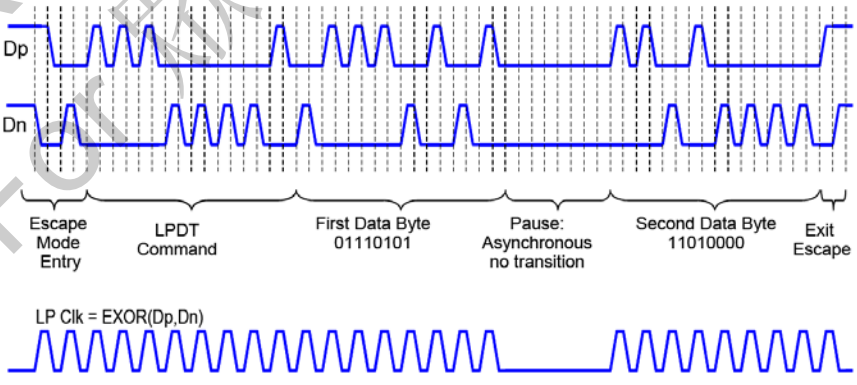

Figure 6.2.3.2.4. Two Data Byte Low-Power Data Transmission Example

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Ultra-Low Power State (ULPS)

The MCU can force data lanes in Ultra-Low Power State (ULPS) mode when data lanes are entering in Escape Mode.

The Ultra-Low Power State (ULPS) is using a following sequence:

- Start: LP-11
- Escape Mode Entry : LP-11 =>LP-10 =>LP-00 =>LP-01 =>LP-00
- Ultra-Low Power State (ULPS) command in Escape Mode: 0001 1110 (First to Last bit)
- Ultra-Low Power State (ULPS) when the MCU is keeping data lanes low
- Mark-1: LP-00 =>LP-10 =>LP-11
- End: LP-11

This sequence is illustrated for reference purposes below:

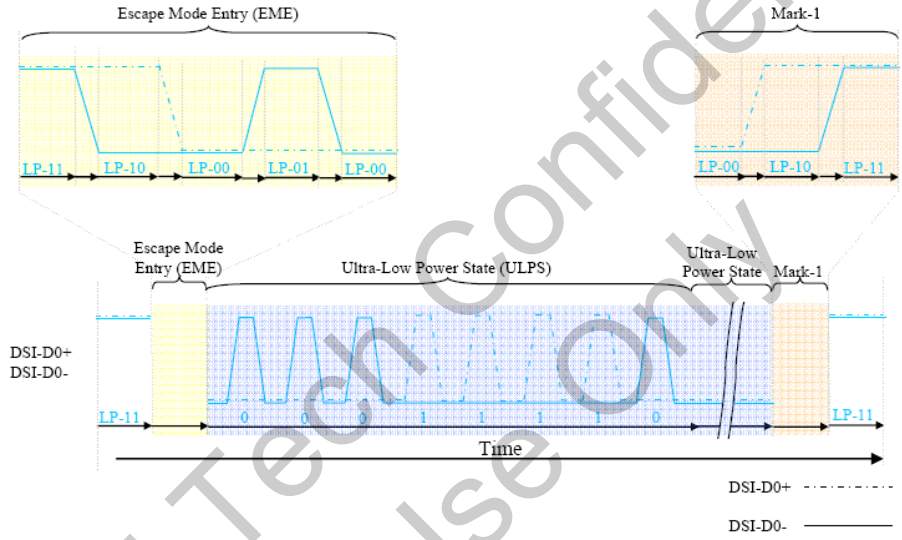

Figure 6.2.3.2.5. Ultra-low power state (ULPS)

Remote Application Reset (RAR)

The MCU can inform to the display module that it should be reseted in Remote Application Reset (RAR) trigger when data lanes are entering in Escape Mode.

The Remote Application Reset is using a following sequence:

- Start: LP-11
- Escape Mode Entry : LP-11 =>LP-10 =>LP-00 =>LP-01 =>LP-00
- Tearing Effect (TEE) trigger in Escape Mode: 0101 1101 (First to Last bit)
- Mark-1: LP-00 =>LP-10 =>LP-11
- End: LP-11

This sequence is illustrated for reference purposes below:

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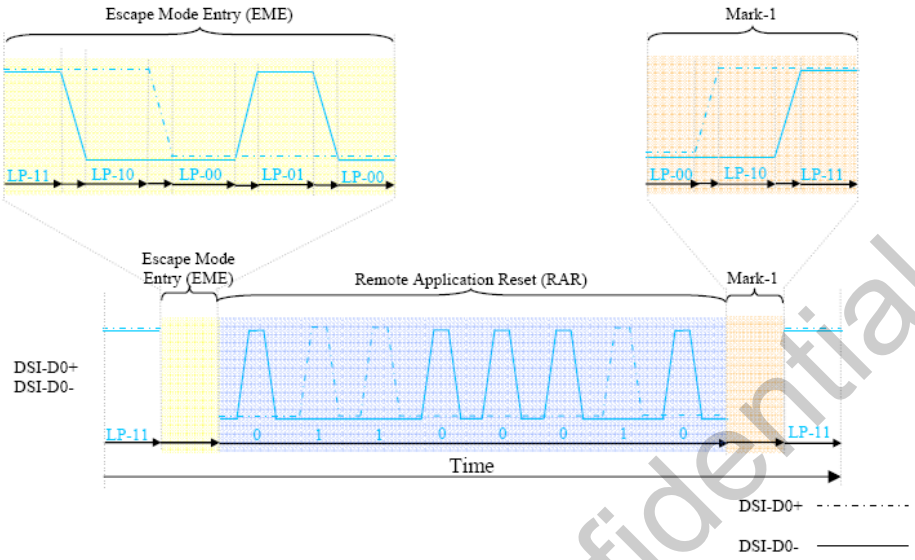

Figure 6.2.3.2.6. Remote Application Reset (RAR)

Tearing Effect (TEE)

The display module can inform to the MCU when a tearing effect event (New V-synch) has been happen on the display module by Tearing Effect (TEE).

The Tearing Effect (TEE) is using a following sequence:

- Start: LP-11
- Escape Mode Entry: LP-11 =>LP-10 =>LP-00 =>LP-01 =>LP-00
- Tearing Effect (TEE) trigger in Escape Mode: 0101 1101 (First to Last bit)
- Mark-1: LP-00 =>LP-10 =>LP-11
- End: LP-11

This sequence is illustrated for reference purposes below:

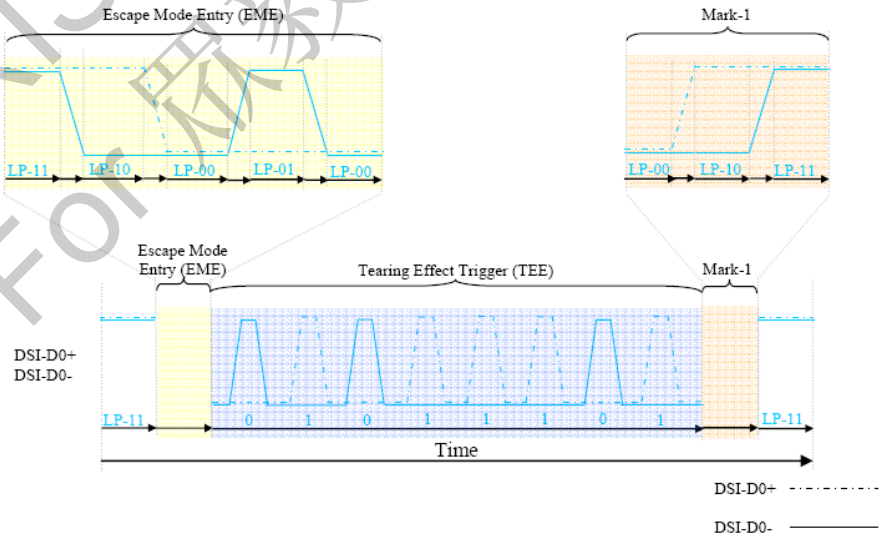

Figure 6.2.3.2.7. Tearing effect (TEE)

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Acknowledgement (ACK)

The display module can inform to the MCU when an error has not recognized on it by Acknowledge (ACK).

The Acknowledge (ACK) is using a following sequence:

- Start: LP-11
- Escape Mode Entry: LP-11 =>LP-10 =>LP-00 =>LP-01 =>LP-00
- Acknowledge (ACK) command in Escape Mode: 0010 0001 (First to Last bit)
- Mark-1: LP-00 =>LP-10 =>LP-11
- End: LP-11

This sequence is illustrated for reference purposes below:

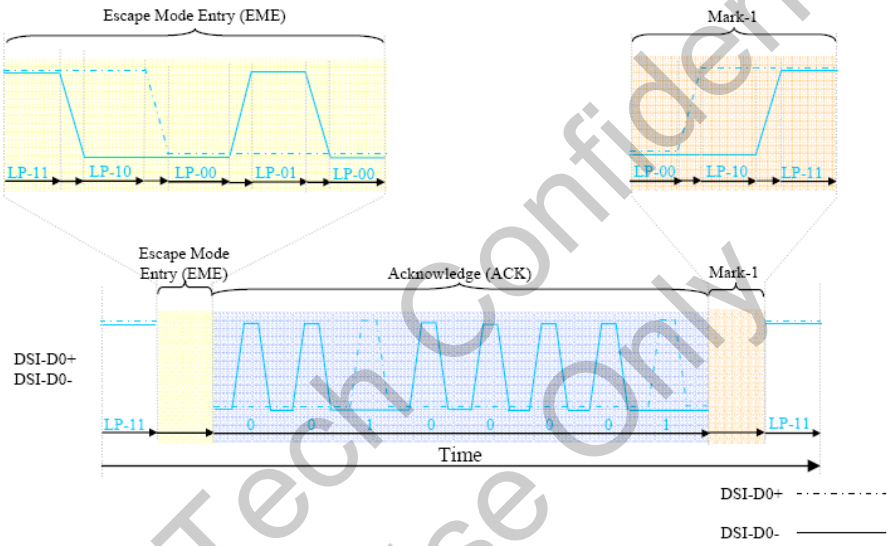

Figure 6.2.3.2.8. Acknowledgement (ACK)

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6.2.3.3. High-Speed Data Transmission (HSDT)

Entering High-Speed Data Transmission (T_{sot} of HSDT)

The display module is entering High-Speed Data Transmission (HSDT) when Clock lanes DSI-CLK+/- have already been entered in the High-Speed Clock Mode (HSCM) by the MCU. See more information on chapter “High-Speed Clock Mode (HSCM)”.

Data lanes DSI-D0+/- of the display module are entering (T_{SOT}) in the High-Speed Data Transmission(HSDT) as follows

- Start: LP-11
- HS-Request: LP-01
- HS-Settle: LP-00 => HS-0 (Rx: Lane Termination Enable)
- Rx Synchronization: 011101 (Tx (= MCU) Synchronization: 0001 1101)
- End: High-Speed Data Transmission (HSDT) – Ready to receive High-Speed Data Load

This same entering High-Speed Data Transmission (T_{SOT} of HSDT) sequence is illustrated below.

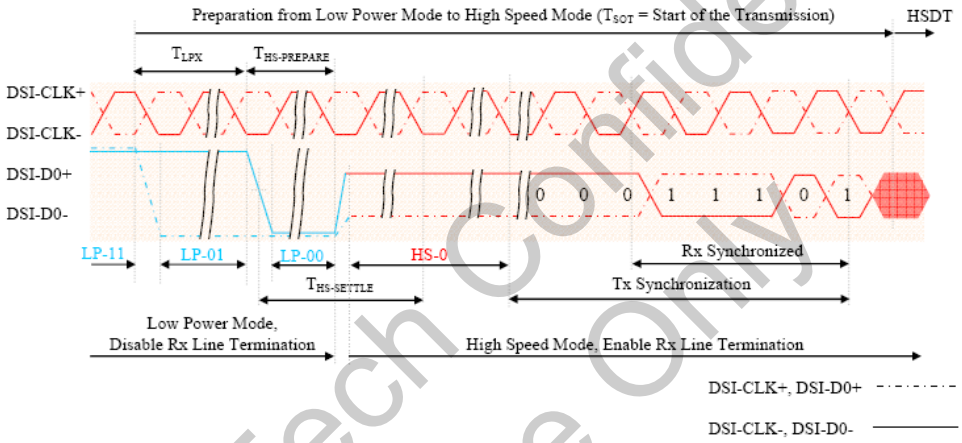

Figure 6.2.3.3.1. T_{sot} of HSDT

Leaving High-Speed Data Transmission (T_{EOT} of HSDT)

The display module is leaving the High-Speed Data Transmission (T_{EOT} of HSDT) when Clock lanes DSI- CLK+/- are in the High-Speed Clock Mode (HSCM) by the MCU and this HSCM is kept until data lanes

DSI-D0+/- are in LP-11 mode. See more information on chapter “7.2.2 High-Speed Clock Mode (HSCM)”.

Data lanes DSI-D0+/- of the display module are leaving from the High-Speed Data Transmission (T_{EOT} of HSDT) as follows

- Start: High-Speed Data Transmission (HSDT)
- Stops High-Speed Data Transmission
  - MCU changes to HS-1, if the last load bit is HS-0
  - MCU changes to HS-0, if the last load bit is HS-1
- End: LP-11 (Rx: Lane Termination Disable)

This same leaving High-Speed Data Transmission (T_{EOT} of HSDT) sequence is illustrated below

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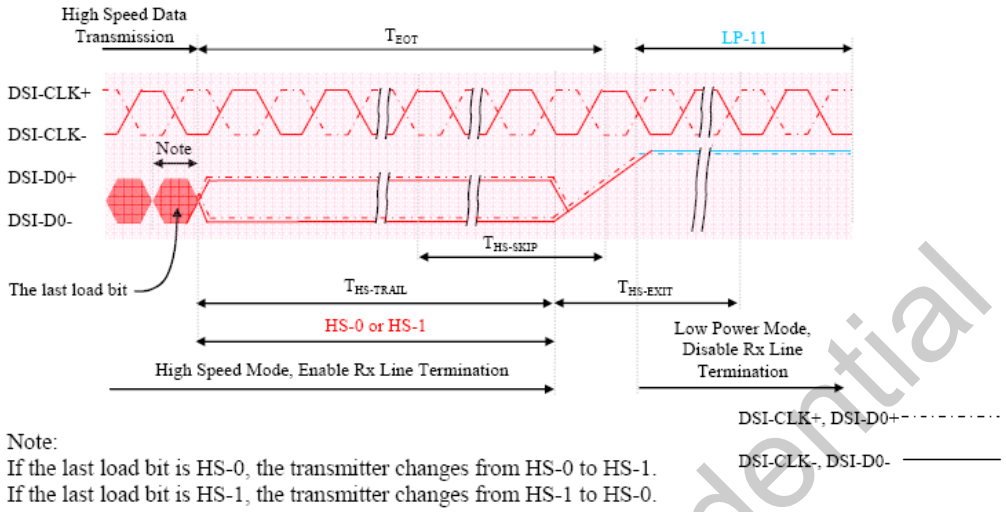

Figure 6.2.3.3.2. T_{EOT} of HSDT

Burst of the High-Speed Data Transmission (HSDT)

The burst of the high-speed data transmission (HSDT) can consist of one data packet or several data packets.

These data packets can be Long (LPa) or Short (SPa) packets. These packets are defined on chapter “Short Packet (SPa) and Long Packet (LPa) Structures“.

These different burst of the High-Speed Data Transmission (HSDT) cases are illustrated for reference purposes below.

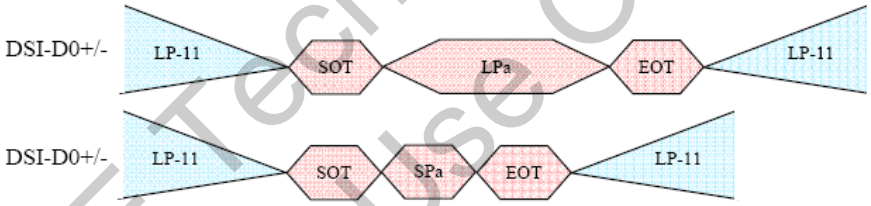

Figure 6.2.3.3.3. Single packet in HSDT

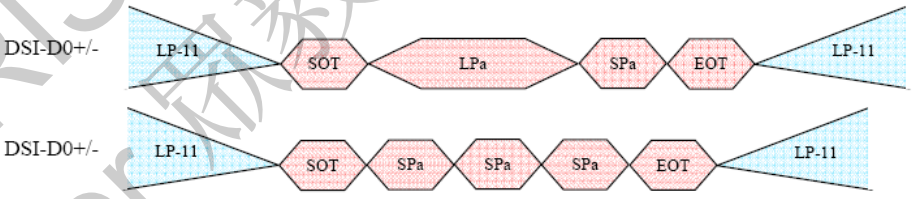

Figure 6.2.3.3.4. Multiple packets in HSDT

Figure 6.2.3.3.5. Packets with EoT package in HSDT

Abbreviation	Explanation
LP-11	Low Power Mode, Data lanes are ‘1’s (Stop Mode)
SOT	Start of the Transmission
LPa	Long Packet
SPa	Short Packet
EOT	End of the Transmission

Table 6.2.3.3.1. Abbreviations

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6.2.3.4. Bus Turnaround (BTA)

The MCU or display module, which is controlling DSI-D0+/- Data Lanes, can start a bus turnaround procedure when it wants information from a receiver, which can be the MCU or display module.

The MCU and display module are using the same sequence when this bus turnaround procedure is used.

This sequence is described for reference purposes, when the MCU wants to do the bus turnaround procedure to the display module, as follows.

- Start (MCU): LP-11
- Turnaround Request (MCU): LP-11 =>LP-10 =>LP-00
- The MCU waits until the display module is starting to control DSI-D0+/- data lanes and the MCU stops to control DSI-D0+/- data lanes (= High-Z)
- The display module changes to the stop mode: LP-00 =>LP-10 =>LP-11

The same bus turnaround procedure (From the MCU to the display module) is illustrated below.

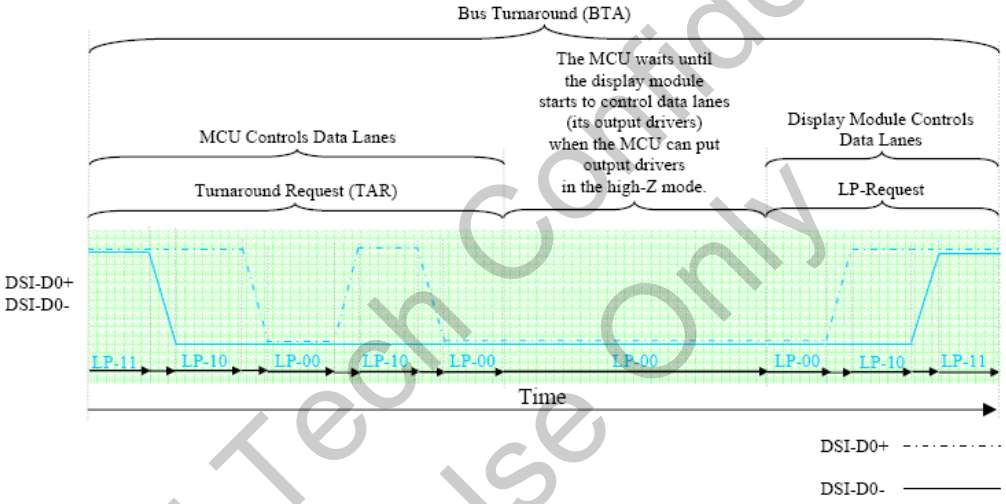

Figure 6.2.3.4.1. Bus turnaround procedure

6.2.3.5. Two Data-lane High Speed Transmission

Since a HS transmission is composed of an arbitrary number of bytes that may not be an integer multiple of the number of lanes, one lane may run out of data before the other. Therefore, the lane management layer, as it buffers up the final set of less-than-2 bytes, de-asserts its “valid data” signal into all lanes for which there’s no further data.

Although all lanes start simultaneously with parallel SoTs, each lane operates independently and may complete the HS transmission before the other lane, sending an EoT one cycle (byte) earlier.

The two PHYs on the receiving end of the link collect bytes in parallel and feed them into the lane management layer. The lane management layer reconstructs the original sequence of bytes in the transmission.

Figure 6.2.3.5.1 shows the way a HS transmission can terminate for two data-lane HS transmission.

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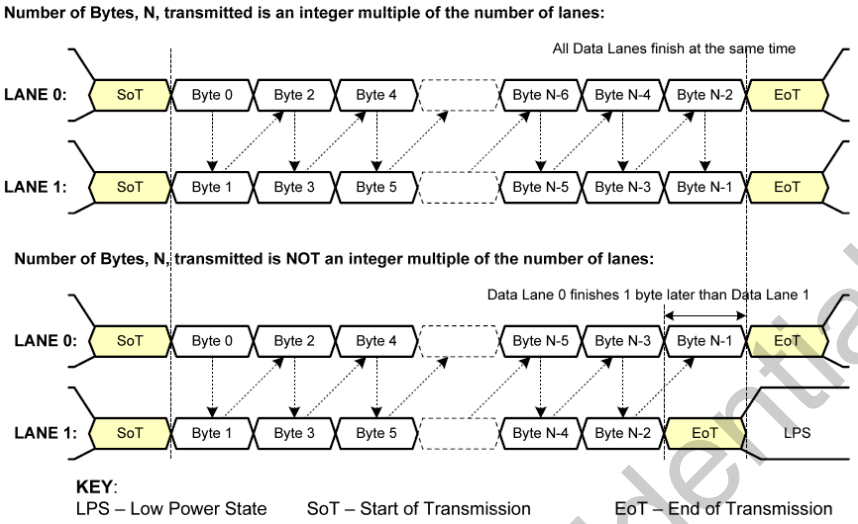


Figure 6.2.3.5.1. Two data-lane HS transmission example

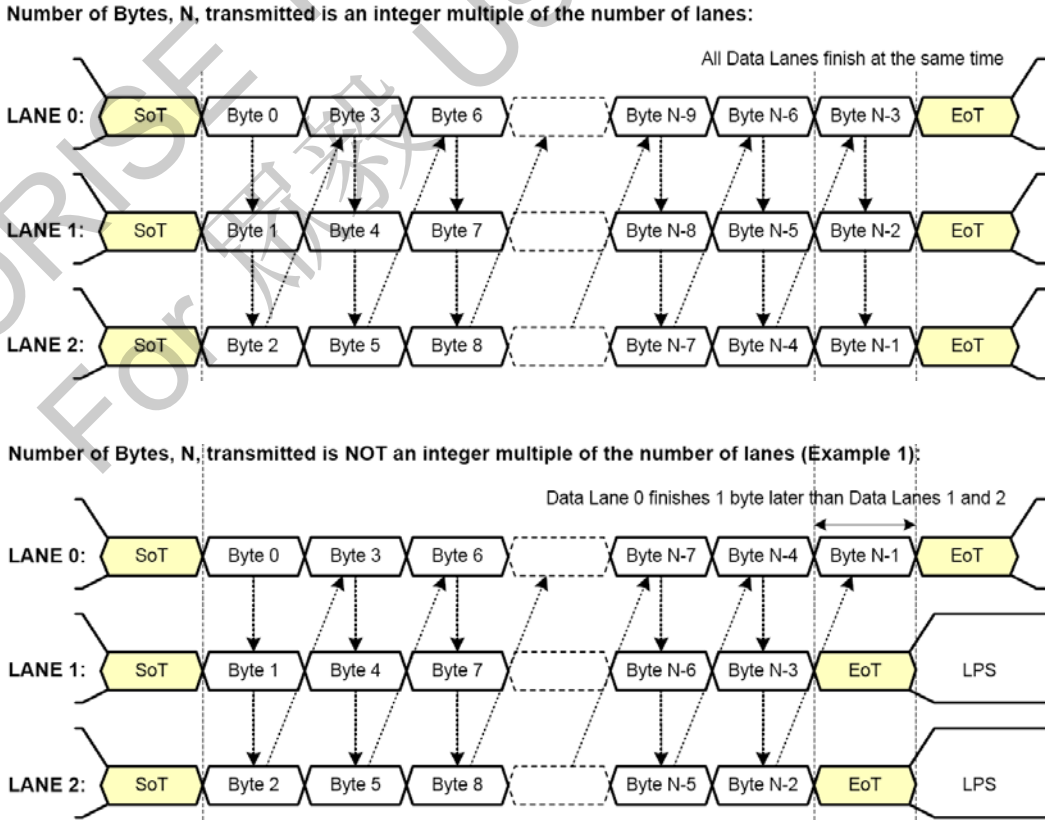
6.2.3.6. Three data-lane high speed transmission

Since a HS transmission is composed of an arbitrary number of bytes that may not be an integer multiple of the number of Lanes, some Lanes may run out of data before others. Therefore, the Lane Management layer, as it buffers up the final set of less-than-N bytes, de-asserts its “valid data” signal into all Lanes for which there is no further data.

Although all Lanes start simultaneously with parallel SoTs, each Lane operates independently and may complete the HS transmission before the other Lanes, sending an EoT one cycle (byte) earlier.

The N PHYs on the receiving end of the Link collect bytes in parallel and feed them into the Lane Management layer. The Lane Management layer reconstructs the original sequence of bytes in the transmission.

Below Figure illustrate a variety of ways a HS transmission can terminate for different number of Lanes and packet lengths.



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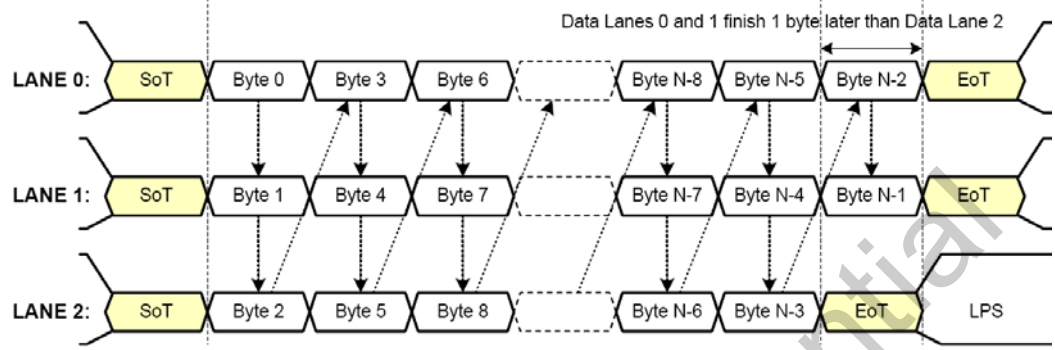
Number of Bytes, N, transmitted is NOT an integer multiple of the number of lanes (Example 2):



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6.2.4. Packet level communication

6.2.4.1. Short Packet (SPa) and Long Packet (LPa) structures

Short Packet (SPa) and Long Packet (LPa) are always used when data transmission is done in Low Power Data Transmission (LPDT) or High-Speed Data Transmission (HSDT) modes.

The lengths of the packets are

- Short Packet (SPa): 4 bytes
- Long Packet (LPa): From 6 to 65,541 bytes

The type (SPa or LPa) of the packet can be recognized from their package headers (PH).

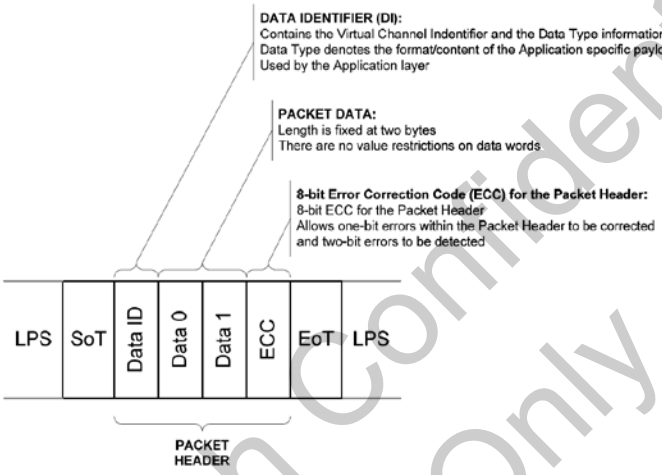

Figure 6.2.4.1.1. Short packet structure

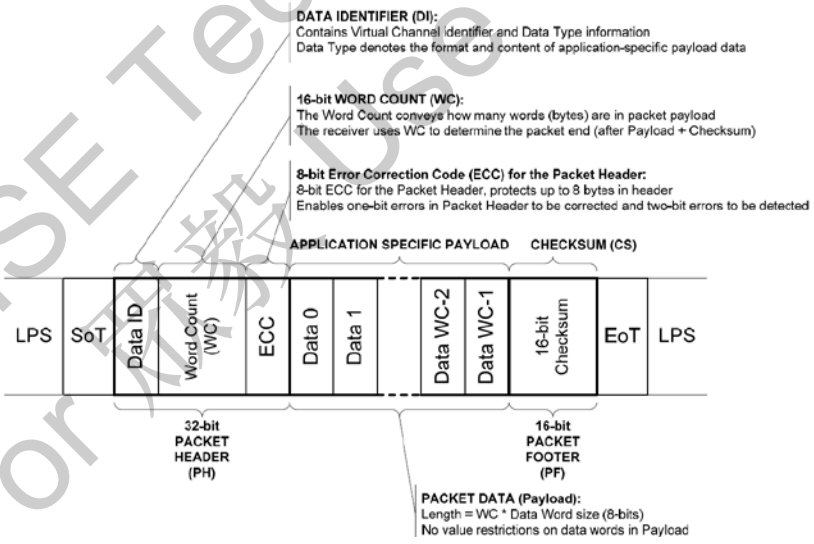

Figure 6.2.4.1.2. Long packet structure

Note:

“Figure 6.2.4.1.1: Short Packet (SPa) Structure” and ”Figure 6.2.4.1.2: Long Packet (LPa) Structure” are presenting a single packet sending (= Includes LP-11, SoT and EoT for each packet sending).

The other possibility is that there is not needed SoT, EoT and LP-11 between packets if packets have sent in multiple packet format. e.g.:

- LP-11 =>SoT =>SPa =>LPa =>SPa =>SPa =>EoT =>LP-11
- LP-11 =>SoT =>SPa =>SPa =>SPa =>EoT =>LP-11
- LP-11 =>SoT =>LPa =>LPa =>LPa =>EoT =>LP-11

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Bit Order of the Byte on Packets

All packet data traverses the interface as bytes. Sequentially, a transmitter shall send data LSB first, MSB last. For packets with multi-byte fields, the least significant byte shall be transmitted first unless otherwise specified.

Figure 6.2.4.1.3 shows a complete Long packet data transmission. Note, the figure shows the byte values in standard positional notation, i.e. MSB on the left and LSB on the right, while the bits are shown in chronological order with the LSB on the left, the MSB on the right and time increasing left to right.

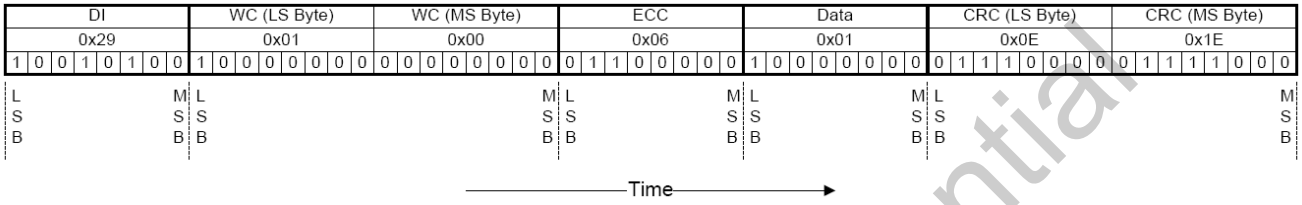

Figure 6.2.4.1.3. Bit order of the byte on packets

Byte Order of the Multiple Byte Information on Packets

Byte order of the multiple bytes information, what is used on packets, is that the Least Significant (LS) Byte of the information is sent in the first and the Most Significant (MS) Byte of the information is sent in the last.

e.g. Word Count (WC) consists of 2 bytes (16 bits) when the LS byte is sent in the first and the MS byte is sent in the last.

This same order is illustrated for reference purposes below.

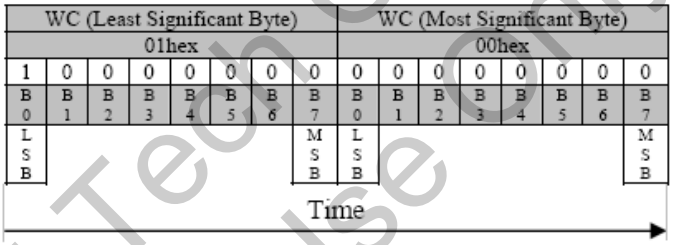

Figure 6.2.4.1.4. Byte order of the multiple byte information on packets

Packet Head (PH)

The packet header is always consisting of 4 bytes. The content of these 4 bytes are different if it is used to Short Packet (SPa) or Long Packet (LPa).

Short Packet (SPa):

- 1st byte: Data Identification (DI) => Identification that this is Short Packet (SPa)
- 2nd and 3rd bytes: Packet Data (PD), Data 0 and 1
- 4th byte: Error Correction Code (ECC)

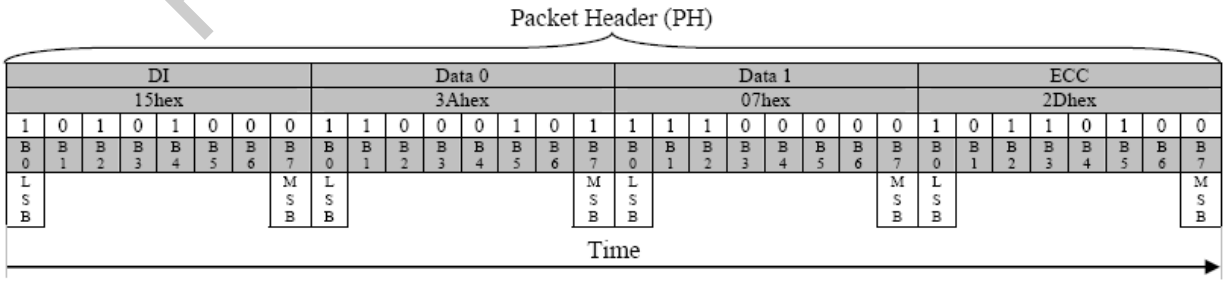

Figure 6.2.4.1.5. Packet head on short packet

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Long Packet (LPa):

- 1st byte: Data Identification (DI) => Identification that this is Long Packet (LPa)
- 2nd and 3rd bytes: Word Count (WC)
- 4th byte: Error Correction Code (ECC)

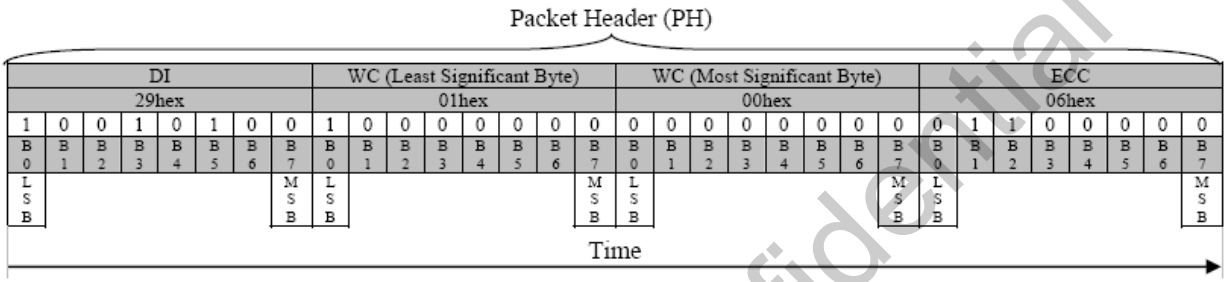

Figure 6.2.4.1.6. Packet head on long packet

Data Identification

Data Identification (DI) is a part of Packet Header (PH) and it consists of 2 parts:

- Virtual Channel (VC), 2 bits, DI[7...6]
- Data Type (DT), 6 bits, DI[5…0]

The Data Identification (DI) structure is illustrated on a table below.

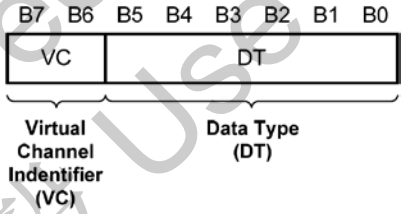

Table 6.2.4.1.7. Data identification structure

Data Identification (DI) is illustrated on Packet Header (PH) for reference purposes below.

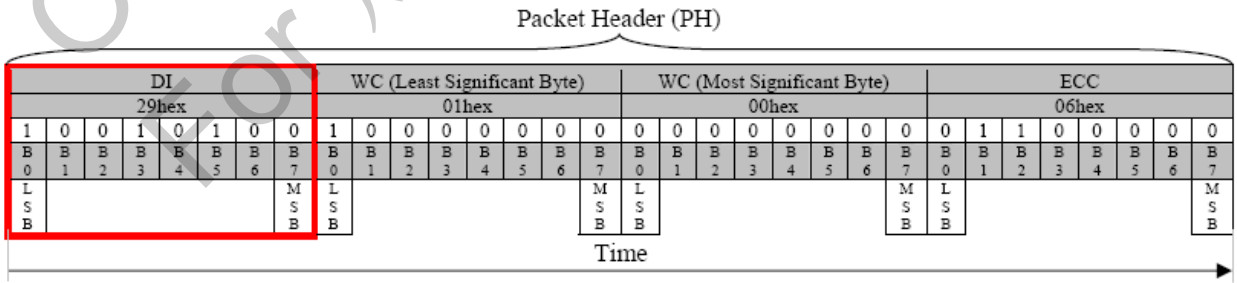

Figure 6.2.4.1.8. Data identification of the packet head

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Virtual Channel (VC)

A processor may service up to four peripherals with tagged commands or blocks of data, using the Virtual Channel ID field of the header for packets targeted at different peripherals.

Virtual Channel (VC) is a part of Data Identification (DI[7…6]) structure and it is used to address where a packet is wanted to send from the MCU. Bits of the Virtual Channel (VC) are illustrated for reference purposes below.

OTM8009A only support VC code=00, package with other VC code(01/10/11) will be filter out.

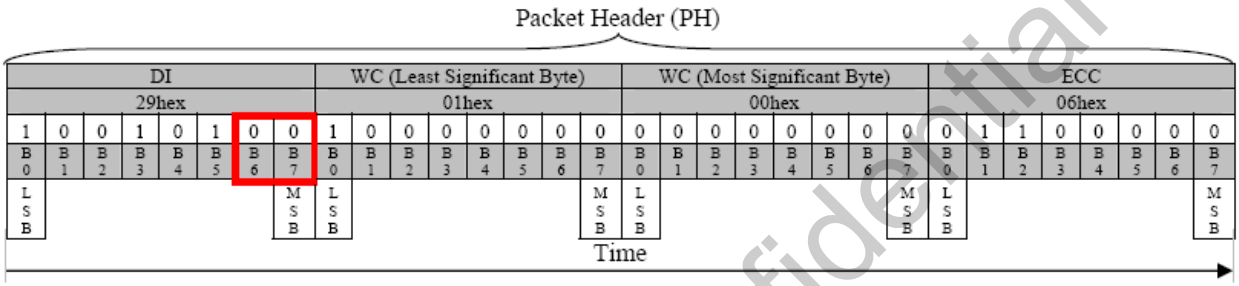

Figure 6.2.4.1.9. Virtual channel on the packet head

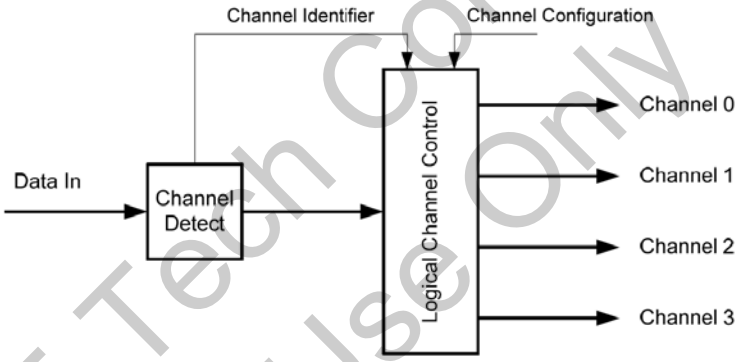

Figure 6.2.4.1.10. Virtual channel block diagram (receiver case)

Data Type (DT)

Data Type (DT) is a part of Data Identification (DI[5...0]) structure and it is used to define a type of the used data on a packet.

Bits of the Data Type (DT) are illustrated for reference purposes below.

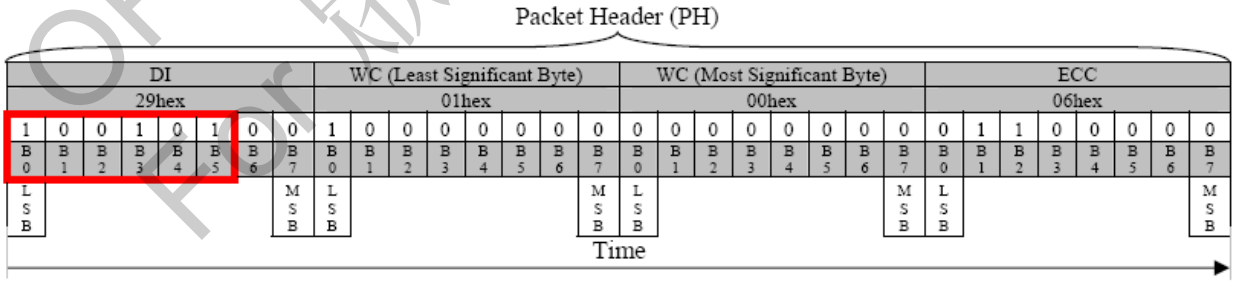

Figure 6.2.4.1.11. Data type on the packet head

This Data Type (DT) also defines what the used packet is: Short Packet (SPa) or Long Packet (LPa). Data Types (DT) are different from the MCU to the display module (or other devices) and vice versa. These Data Type (DT) are defined on tables below.

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From the MCU to the Display module		
Data Type (HEX)	Data Type (Binary)	Description
01h	00 0001	Sync Event, V Sync Start
11h	01 0001	Sync Event, V Sync End
21h	10 0001	Sync Event, H Sync Start
31h	11 0001	Sync Event, H Sync End
08h	00 1000	End of Transmission (EoT) packet
02h	00 0010	Color Mode (CM) Off Command
12h	01 0010	Color Mode (CM) On Command
22h	01 0010	Shut Down Peripheral Command
32h	11 0010	Turn On Peripheral Command
03h	00 0011	Generic Short WRITE, no parameters
13h	01 0011	Generic Short WRITE, 1 parameters
23h	10 0011	Generic Short WRITE, 2 parameters
04h	00 0100	Generic READ, no parameters
14h	01 0100	Generic READ, 1 parameters
24h	10 0100	Generic READ, 2 parameters
05h	00 0101	DCS WRITE, no parameters
15h	01 0101	DCS WRITE, 1 parameters
06h	00 0110	DCS READ, no parameters
37h	11 0111	Set Maximum Return Packet Size
09h	00 1001	Null Packet, no data
19h	01 1001	Blanking Packet, no data
29h	10 1001	Generic Long Write
39h	11 1001	DCS Long Write/write_LUT Command Packet
0Eh	00 1110	Packed Pixel Stream, 16-bit RGB, 5-6-5 Format
2Eh	10 1110	Loosely Packed Pixel Stream, 18-bit RGB, 6-6-6 Format
3Eh	11 1110	Packed Pixel Stream, 24-bit RGB, 8-8-8 Format

Table 6.2.4.1.12. Data type from the MCU to the display module

From the Display Module to the MCU		
Data Type (HEX)	Data Type (Binary)	Description
02h	00 0010	Acknowledge & Error Report
1Ch	01 1100	DCS Long READ Response
21h	10 0001	DCS Short READ Response, 1 byte returned
22h	10 0010	DCS Short READ Response, 2 byte returned

Table 6.2.4.1.13. Data type from the display module to the MCU

The receiver is ignored other Data Type (DT) if they are not defined on tables above.

Host send “Generic Read” data type, OTM8009A will return DCS Read package to Host.

Packet data on the short packet

Packet Data (PD) of the Short Packet (SPa) is defined after Data Type (DT) of the Data Identification (DI) has indicated that Short Packet (SPa) is wanted to send.

Packet Data (PD) of the Short Packet (SPa) consists of 2 data bytes: Data 0 and Data 1.

Packet Data (PD) sending order is that Data 0 is sent in the first and the Data 1 is sent in the last.

Bits of Data 1 are set to 00h, if the information length is 1 byte.

Packet Data (PD) of the Short Packet (SPa), when the length of the information is 1 or 2 bytes are illustrated for reference purposes below.

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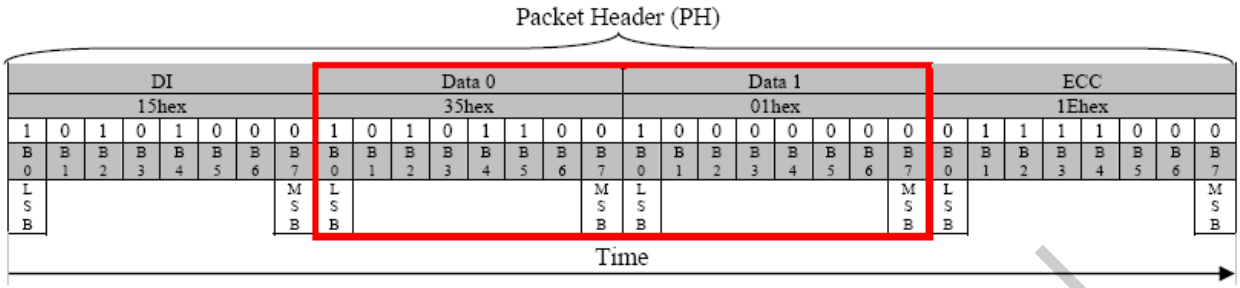

Figure 6.2.4.1.14. Packet data on the short packet, 2 bytes information

Packet Data (PD) information:

- Data 0: 10hex
- Data 1: 00hex (Null)

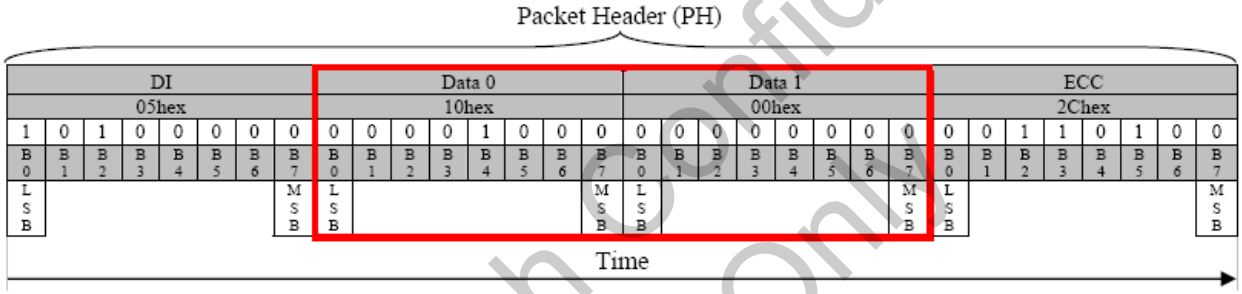

Figure 6.2.4.1.15. Packet data on the short packet, 1 bytes information

Word count on the long packet

Word Count (WC) of the Long Packet (LPa) is defined after Data Type (DT) of the Data Identification (DI)has indicated that Long Packet (LPa) is wanted to send.

Word Count (WC) indicates a number of the data bytes of the Packet Data (PD) what is wanted to send after Packet Header (PH) versus Packet Data (PD) of the Short Packet (SPa) is placed in the Packet Header (PH).

Word Count (WC) of the Long Packet (LPa) consists of 2 bytes.

These 2 bytes of the Word Count (WC) sending order is that the Least Significant (LS) Byte is sent in the first and the Most Significant (MS) Byte is sent in the last.

Word Count (WC) of the Long Packet (LPa) is illustrated for reference purposes below.

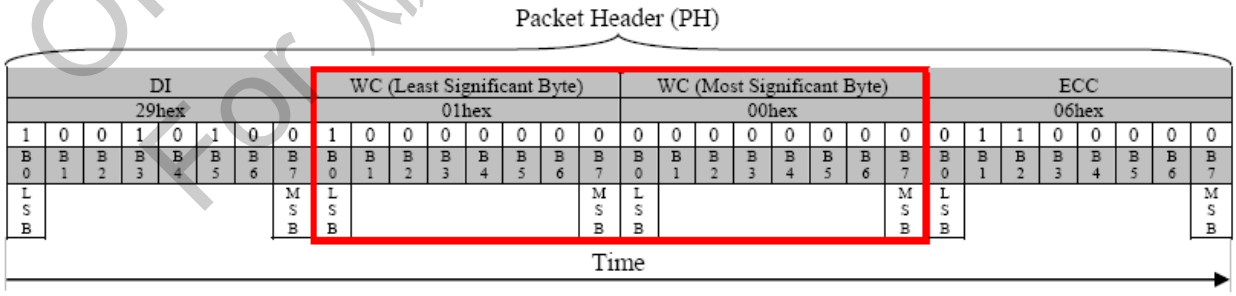

Figure 6.2.4.1.16. Word count on the long packet

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Error Correction Code (ECC)

Error Correction Code (ECC) is a part of Packet Header (PH) and its purpose is to identify an error or errors:

- Short Packet (SPa): Data Identification (DI) and Packet Data (PD) bytes (24 bits: D[23…0])
- Long Packet (LPa): Data Identification (DI) and Word Count (WC) bytes (24 bits: D[23…0])

D[23…0] is illustrated for reference purposes below.

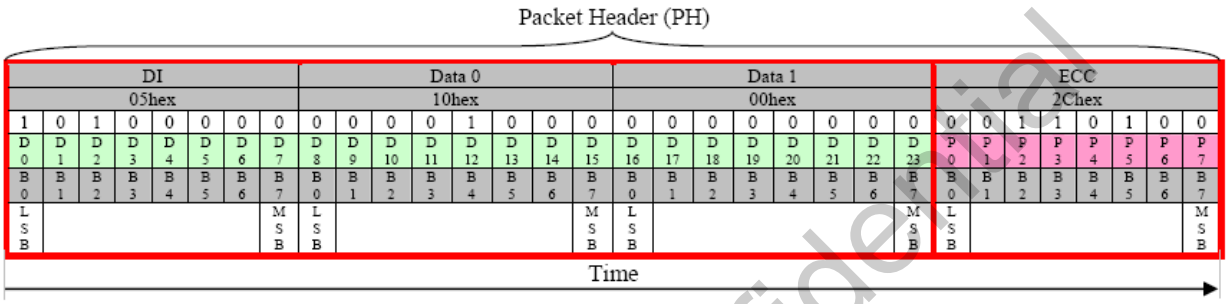

Figure 6.2.4.1.17. D[23:0] and P[7:0] on the short packet

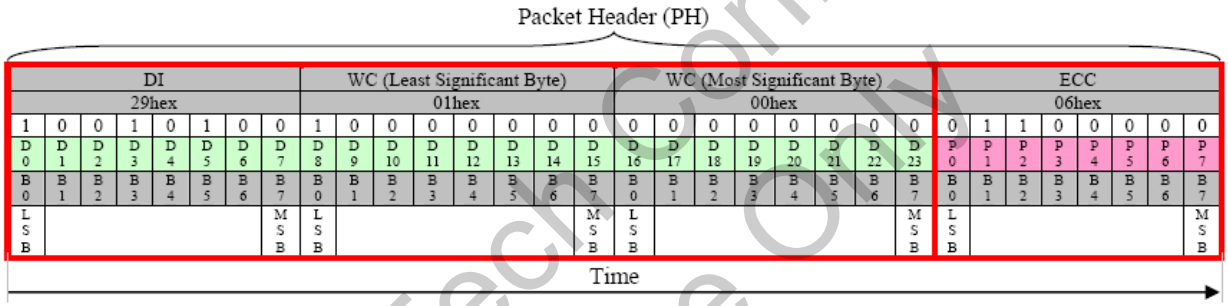

Figure 6.2.4.1.18. D[23:0] and P[7:0] on the long packet

Error Correction Code (ECC) can recognize one error or several errors and makes correction in one bit error case.

Bits (P[7…0]) of the Error Correction Code (ECC) are defined, where the symbol '^' is presenting XOR function (Pn is '1' if there is odd number of '1's and Pn is '0' if there is even number of '1's), as follows.

- P7 = 0
- P6 = 0
- P5 = D10^D11^D12^D13^D14^D15^D16^D17^D18^D19^D21^D22^D23
- P4 = D4^D5^D6^D7^D8^D9^D16^D17^D18^D19^D20^D22^D23
- P3 = D1^D2^D3^D7^D8^D9^D13^D14^D15^D19^D20^D21^D23
- P2 = D0^D2^D3^D5^D6^D9^D11^D12^D15^D18^D20^D21^D22
- P1 = D0^D1^D3^D4^D6^D8^D10^D12^D14^D17^D20^D21^D22^D23
- P0 = D0^D1^D2^D4^D5^D7^D10^D11^D13^D16^D20^D21^D22^D23

P7 and P6 are set to '0' because Error Correction Code (ECC) is based on 64 bit value ([D63…0]), but this implementation is based on 24 bit value (D[23…0]). Therefore, there is only needed 6 bits (P[5…0]) for Error Correction Code (ECC).

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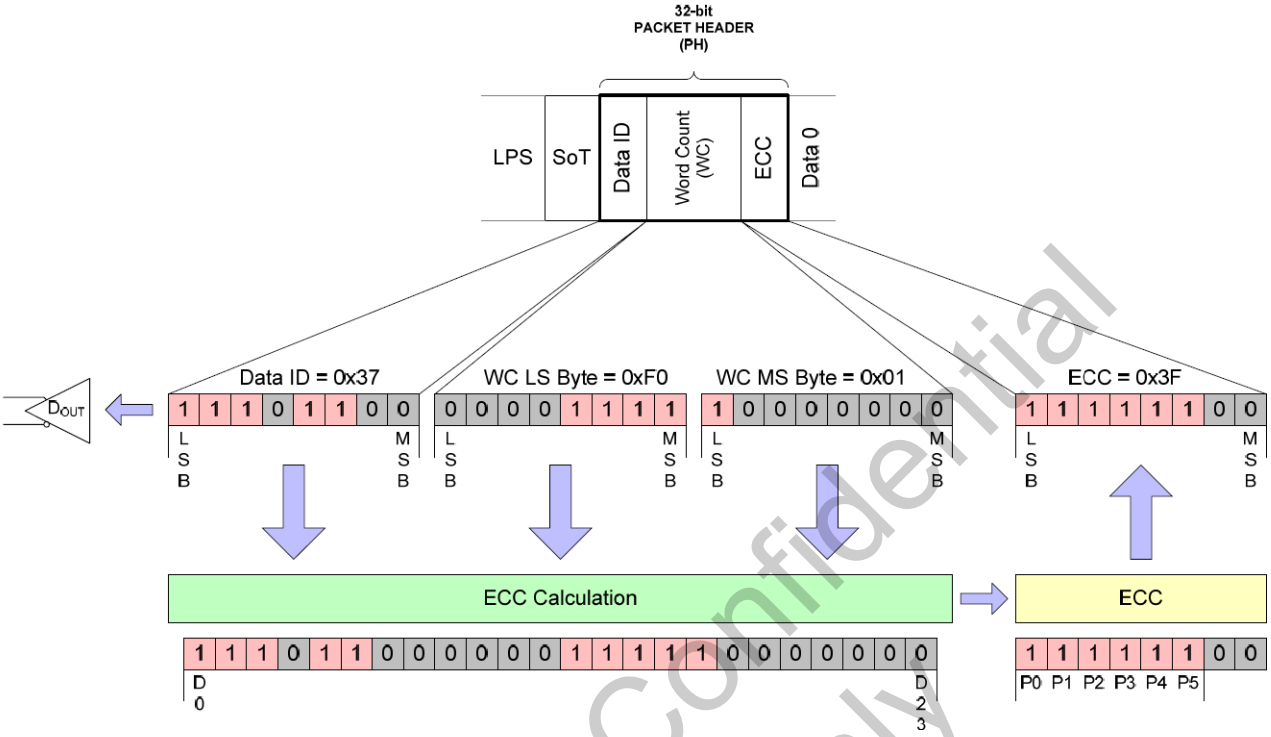

Figure 6.2.4.1.19 24-bit ECC generation on TX side (Example)

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Packet footer on the long packet

Packet Footer (PF) of the Long Packet (LPa) is defined after the Packet Data (PD) of the Long Packet (LPa). The Packet Footer (PF) is a checksum value what is calculated from the Packet Data of the Long Packet (LPa).

The checksum is using a 16-bit Cyclic Redundancy Check (CRC) value which is generated with a polynomial X16+X12+X5+X0 as it is illustrated below.

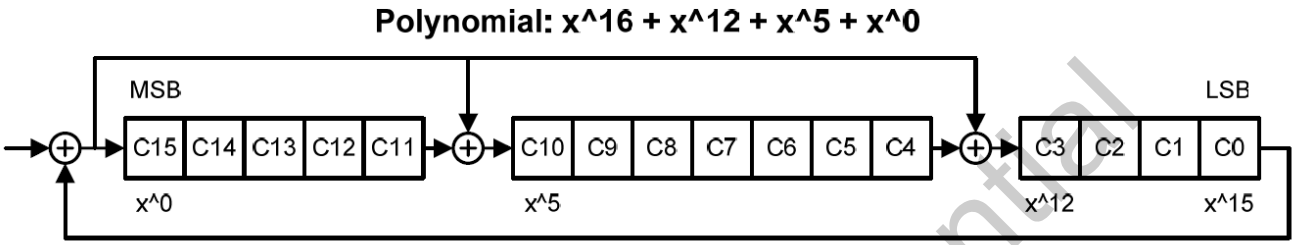

Figure 6.2.4.1.20 16-bit cyclic redundancy check (CRC) calculation

The 16-bit Cyclic Redundancy Check (CRC) generator is initialized to FFFFh before calculations.

The Most Significant Bit (MSB) of the data byte of the Packet Data (PD) is the first bit what is inputted into the 16-bit Cyclic Redundancy Check (CRC).

The receiver is calculated own checksum value from received Packet Data (PD). The receiver compares own checksum and the Packet Footer (PF) what the transmitter has sent.

The received Packet Data (PD) and Packet Footer (PF) are correct if the own checksum of the receiver and Packet Footer (PF) are equal and vice versa the received Packet Data (PD) and Packet Footer (PF) are not correct if the own checksum of the receiver and Packet Footer (PF) are not equal.

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6.2.4.2. Packet transmissions

Packet from the MCU to the display module

Display Command Set (DCS), which is defined on chapter “Instructions” is used from the MCU to the display module.

This Display Command Set (DCS) is always defined on the Data 0 of the Packet Data (PD), which is included in Short Packet (SPa) and Long packet (LPa) as these are illustrated below.

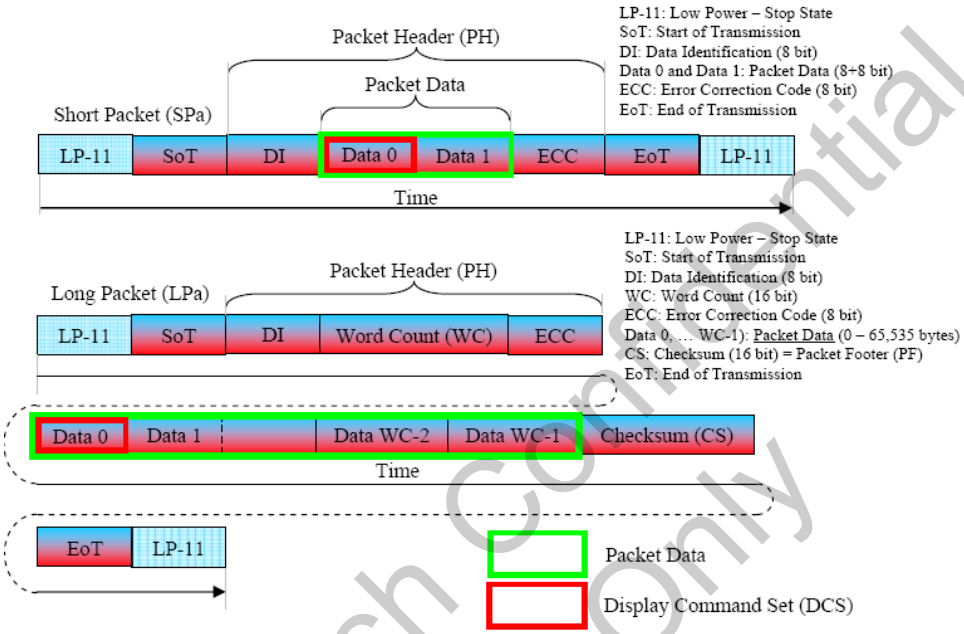

Figure 6.2.4.2.1. DCS on the short packet and long packet

Packet from the display module to the MCU

Used packet types

The display module is always using Short Packet (SPa) or Long Packet (LPa), when it is returning information to the MCU after the MCU has requested information from the Display Module. This information can be a response of the Display Command Set (DCS).

The used packet type is defined on Data Type (DT). See chapter “7.5.4.1.3.1.2. Data Type (DT)”.

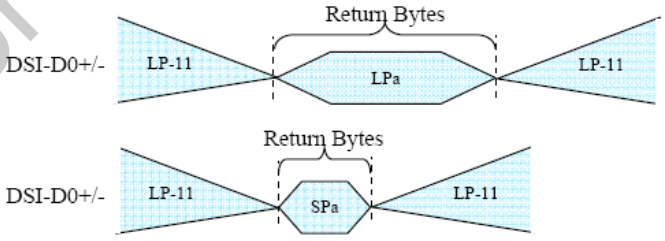

Figure 6.2.4.2.2. Return bytes on single packet

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Acknowledge with Error Report (AwER)

"Acknowledge with Error Report" (AwER) is always using a Short Packet (SPa), what is defined on Data Type (DT, 00 0010b), from the display module to the MCU.

The Packet Data (PD) can include bits, which are defining the current error, when a corresponding bit is set to 1 , as they are defined on the following table.

Bit	Description
0	SoT Error
1	SoT Sync Error
2	EoT Sync Error
3	Escape Mode Entry Command Error
4	Low-Power Transmit Sync Error
5	~~High Speed Receive Timeout Error~~ Any Protocol Timer Time-Out
6	False Control Error
7	~~Reserved, Set to '0' internally~~ Contention is Detected on the Display Module
8	ECC Error, single-bit (detected and corrected)
9	ECC Error, multi-bit (detected, not corrected)
10	Checksum Error
11	DSI Data Type (DT) Not Recognized
12	DSI Virtual Channel (VC) ID Invalid
13	Invalid Transmission Length
14	Reserved, Set to '0' internally
15	DSI Protocol Violation

Figure 6.2.4.2.3. Acknowledge with error report for long packet response

Bit	Description
0	SoT Error
1	SoT Sync Error
2	EoT Sync Error
3	Escape Mode Entry Command Error
4	Low-Power Transmit Sync Error
5	~~High Speed Receive Timeout Error~~ Any Protocol Timer Time-Out
6	False Control Error
7	~~Reserved, Set to '0' internally~~ Contention is Detected on the Display Module
8	ECC Error, single-bit (detected and corrected)
9	ECC Error, multi-bit (detected, not corrected)
10	Set to '0' internally (Only for Long Packet (LP)
11	DSI Data Type (DT) Not Recognized
12	DSI Virtual Channel (VC) ID Invalid
13	Invalid Transmission Length
14	Reserved, Set to '0' internally
15	DSI Protocol Violation

Figure 6.2.4.2.4. Acknowledge with error report for short packet response

These errors are only included on the last packet, which has been received from the MCU to the display module, before Bus Turnaround (BTA).

The display module ignores the received packet which includes error or errors.

Acknowledge with Error Report (AwER) of the Short Packet (SPa) is defined e.g.

- Data Identification (DI)
  - Virtual Channel (VC, DI[7…6]): 00b
  - Data Type (DT, DI[5…0]): 00 0010b
- Packet Data (PD)
  - Bit 8: ECC Error, single-bit (detected and corrected)
  - AwER: 0100h
- Error Correction Code (ECC)

This is defined on the Short Packet (SPa) as follows.

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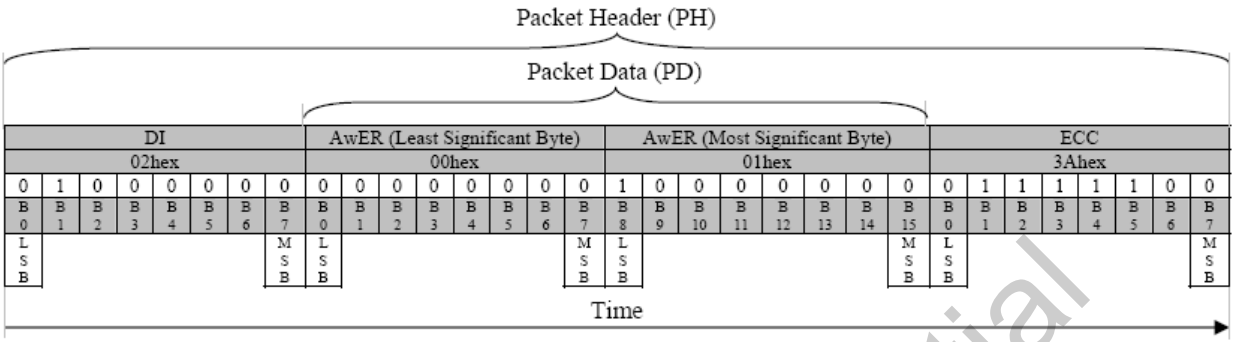

Figure 6.2.4.2.5. Acknowledge with error report – example

6.2.5. Customer-defined generic read data type format

The short packet of Data Type 24h (Generic READ, 2 parameters) specifies the register content for read and the Nth parameter that will begin reading. After Data Type 24h is received, BTA is executed. Then, the Nth parameter becomes the first data, and the number of data of WC (word count) value is output.

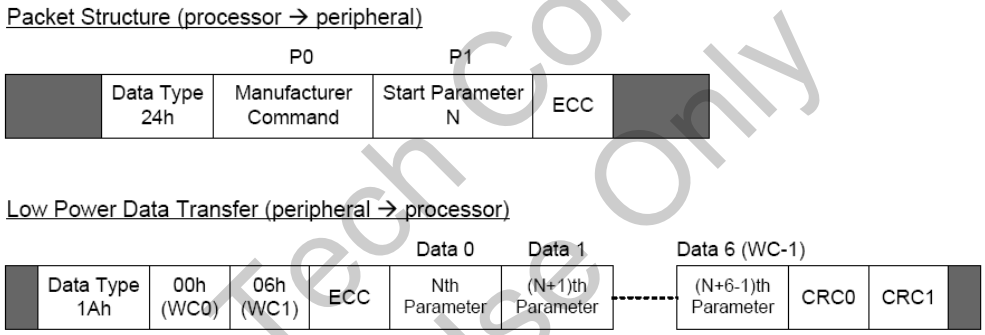

Figure 6.2.5.1. Generic read data type format

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6.2.6. MIPI interface power on/off sequence

The MIPI interface control the normal/shutdown mode by the Sleep-out signal, the on/off sequence as shown in figure as follow.

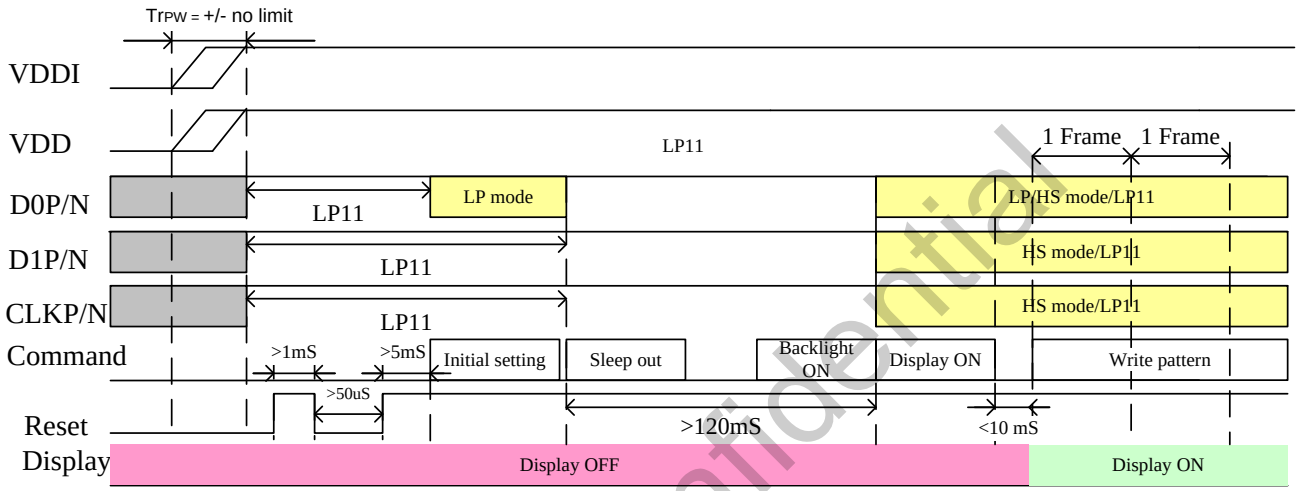

Figure 6.2.6.1 MIPI interface Power on and shutdown recovery sequence Power on and shutdown recovery sequence.

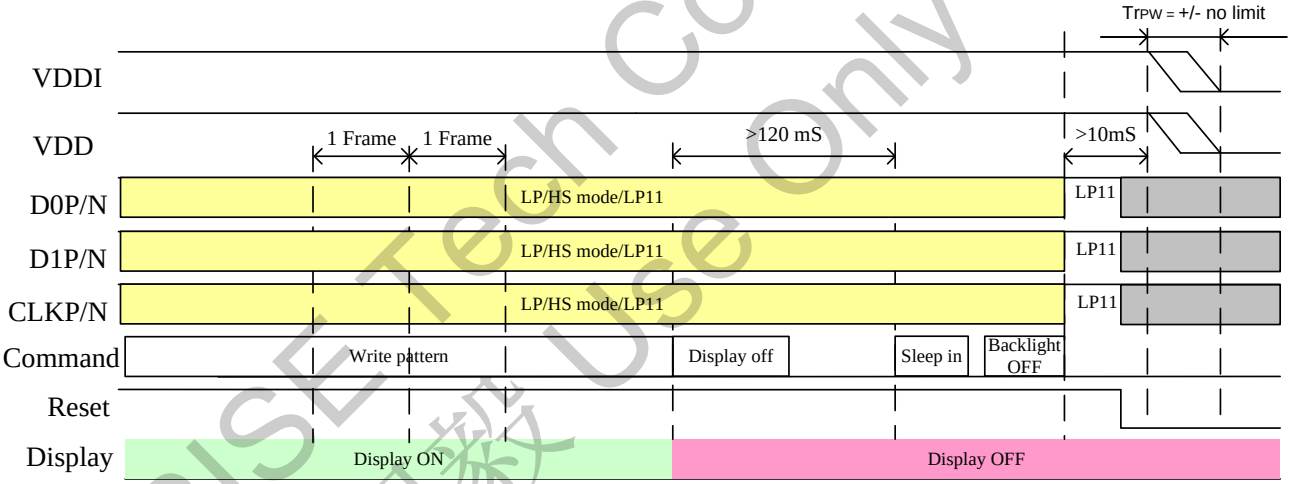

Figure 6.2.6.2 MIPI interface Power off and shutdown sequence

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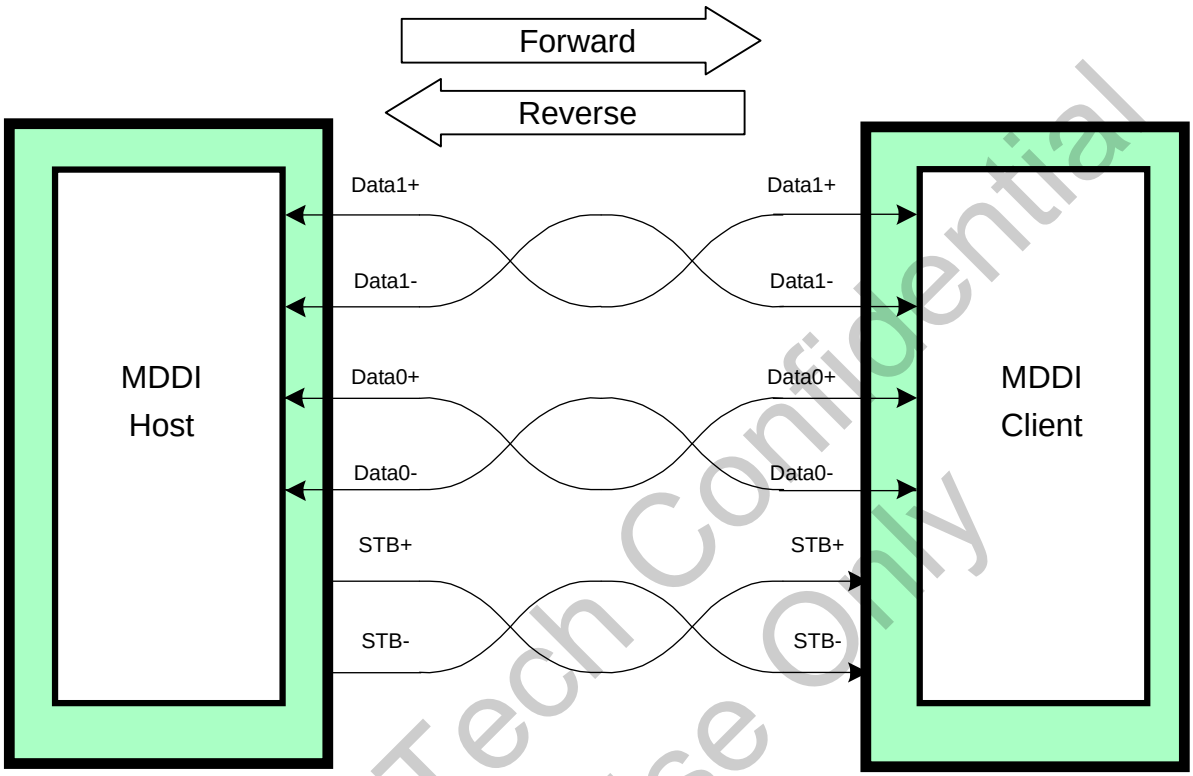
6.3. MDDI Interface

6.3.1. General description

The MDDI is a differential and serial interface with high speed. The OTM8009A support the MDDI Type 1 and Type 2.



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6.3.2. MDDI Packet summary

The OTM8009A support packet type as shown in table.

Table 6.3.2.1 The support packet type

	Packet Name	Packet Type (Dec)	Direction
Link Control Packets	Sub-frame header packet	15359	Forward
	Filler packet	0	Forward
	Reverse link encapsulation packet	65	Forward
	Link shutdown packet	69	Forward
	Round-trip delay measurement packet	82	Forward
Basic Media Stream Packets	Video stream packet	16	Forward
Client Status and Control Packets	Client capability packet	66	Reverse
	Client request and status packet	70	Reverse
	Register access packet	146	Forward / Reverse

6.3.3. MDDI Packet format

The structure of the forward link is illustrated in Figure 6.2.3.1. Information transmitted over the MDDI link is grouped into packets. The definition of the types of packets is given later in this section. Multiple packets are grouped together into a sub-frame, and multiple sub-frames make up a media- frame. Every sub-frame begins with a special packet called a Sub-frame Header Packet.

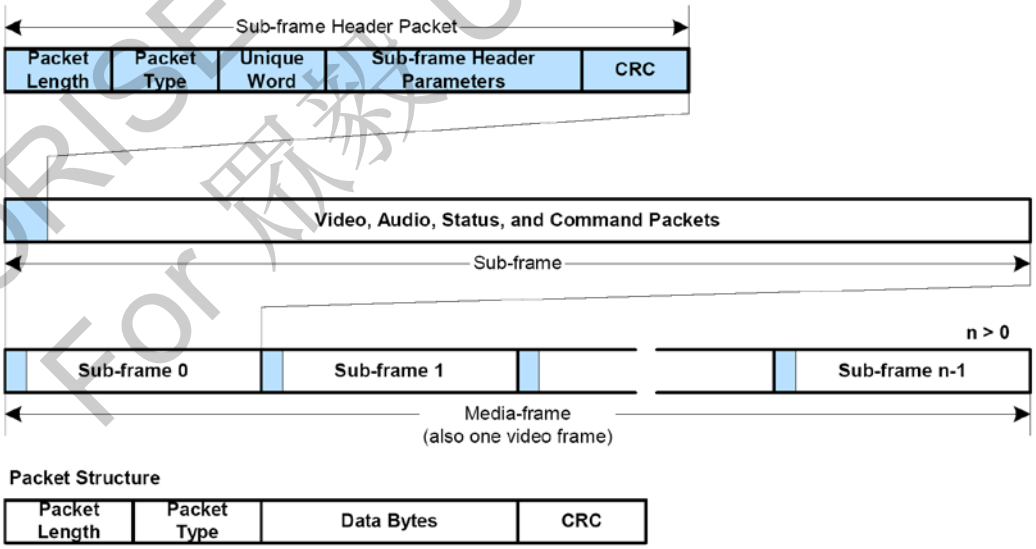

Table 6.3.3.1 Forward link structure

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6.3.3.1. Sub frame header packet

The Sub-Frame Header Packet is the first packet of every sub-frame, and its basic structure is illustrated in Figure 6.2..3.1.1. The Sub-Frame Header Packet is required for host-client synchronization. Every host shall be able to generate this packet, and every client shall be able to receive and interpret this packet.

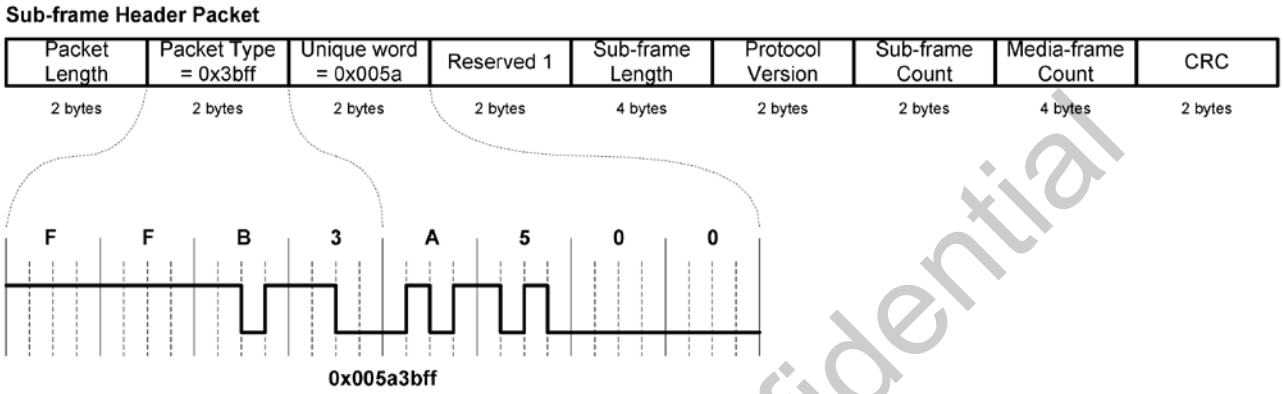

Figure 6.3.3.1.1 Sub frame header packet format

Packet Contents:

- Packet Length – 2 bytes that contain a 16-bit unsigned integer that specifies the total number of bytes in the packet not including the packet length field. The Packet Length of this packet is always 20.
- Packet Type – 2 bytes that contain a 16-bit unsigned integer. A Packet Type of 15359 (0x3bff hexadecimal) identifies the packet as a Sub-frame Header Packet.
- Unique Word – 2 bytes that contain a 16-bit unsigned integer that contains the 16 most significant bits of the unique word. The 4-byte combination of the Packet Type and Unique Word together form a 32-bit unique word with good autocorrelation. The actual unique word is 0x005a3bff where the lower 16 bits are transmitted first as the Packet Type, and the most significant 16 bits are transmitted immediately afterward.
- Reserved 1 – 2 bytes that contain a 16-bit unsigned integer that is reserved for future use. All bits in this field shall be set to zero. The purpose of this field is to cause all subsequent 2 byte fields to align to a 16-bit word address and cause 4-byte fields to align to a 32-bit word address. The least significant byte is reserved to indicate that the host is capable of addressing multiple client devices. A value of zero is reserved to indicate that the host is capable of operating only with a single client device.
- Sub-frame Length – 4 bytes that contain a 32-bit unsigned integer that specifies the number of bytes per sub-frame. It is valid to change the Sub-frame Length on-the-fly from one sub-frame to the next. This is useful in order to make minor timing adjustments in the sync-pulses for isochronous streams. If the CRC of the Sub-frame Header packet is not valid then the link controller shall use the Sub-frame Length of the previous known-good Sub-frame Header packet to estimate the length of the current sub-frame.
- Protocol Version – 2 bytes that contain a 16-bit unsigned integer that specifies the protocol version used by the host. The Protocol Version field shall be set to 0 to specify the version of the protocol described in this document.
- Sub-frame Count – 2 bytes that contain a 16-bit unsigned integer that specifies a sequence number that indicates the number of sub-frames that have been transmitted since the beginning of the media-frame. The first sub-frame of the media-frame has a Sub-frame Count of zero. The last sub-frame of the media-frame has a value of n-1, where n is the number of sub-frames per media-frame. The value in the Sub-frame Count field shall be equal to the Sub-frame Count sent in the previous Sub-frame Header Packet plus 1, except for the first sub-frame of a media-frame when the Sub-frame Count shall be zero.
- Media-frame Count – 4 bytes that contain a 32-bit unsigned integer that specifies a sequence number that indicates the number of media-frames that have been transmitted since the beginning of the present media item. The first media-frame of the media item has a Media- frame Count of zero. The Media-frame Count increments immediately prior to the first sub- frame of each media-frame and wraps back to zero after the maximum Media-frame Count (media-frame number 232-1 = 4,294,967,295) is used. The Media-frame Count value may be reset at any time by the host to suit the needs of the end application.
- CRC – 2 bytes that contain a 16-bit CRC of all bytes in the packet including the Packet Length.

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6.3.3.2. Video stream packet

The Video Stream Packets carry video data to update a rectangular region of the display. The size of this region may be as small as a single pixel or as large as the entire display. There may be an unlimited number of streams displayed simultaneously (limited only by system resources) because all context required to display a stream is contained within the Video Stream Packet. The format of the Video Stream Packet is illustrated in Figure 6.2.3.2.1. The client shall indicate its capability to receive a Video Stream Packet via the RGB Capability, Monochrome Capability, and Y Cr Cb Capability fields of the Client Capability Packet.

Packet Length	Packet Type = 16	bClient ID	Video Data Format Descriptor	Pixel Data Attributes	X Left Edge	Y Top Edge	X Right Edge	Y Bottom Edge
2 bytes	2 bytes	2 bytes	2 bytes	2 bytes	2 bytes	2 bytes	2 bytes	2 bytes

X Start	Y Start	Pixel Count	Parameter CRC	Pixel Data	Pixel Data CRC
2 bytes	2 bytes	2 bytes	2 bytes	Packet Length - 26 bytes	2 bytes

Figure 6.3.3.2.1 Video stream packet

Packet Contents:

- Packet Length – 2 bytes that contain a 16-bit unsigned integer that specifies the total number of bytes in the packet not including the packet length field.
- Packet Type – 2 bytes that contain a 16-bit unsigned integer. A Packet Type of ‘0010h’ identifies the packet as a Video Stream Packet.
- bClient ID – 2 bytes that contain a 16-bit unsigned integer reserved for the Client ID. This field is reserved for future use and shall be set to ‘0000h’.
- Video Data Format Descriptor – 2 bytes that contain a 16-bit unsigned integer that specifies the format of each pixel in the Pixel Data in the present stream in the present packet.

  bits[15:13] = 010 : Value fixed.

  bits[12] = 1 : Only packed type is available (fixed value)

  bits[11:0] = 010101100101 (565h) : 16bpp (RGB(565))

  = 011001100110 (666h) : 18bpp (RGB(666)

  = 100010001000 (888h) : 24bpp (RGB(888))

MDDI Data Type		D7	D6	D5	D4	D3	D2	D1	D0	Color
RGB 5:6:5	Byte n	G2	G1	G0	B4	B3	B2	B1	B0	65K-Color
	Byte n+1	R4	R3	R2	R1	R0	G5	G4	G3	
RGB 6:6:6	Byte n	G1	G0	B5	B4	B3	B2	B1	B0	262K-Color
	Byte n+1	R3	R2	R1	R0	G5	G4	G3	G2	
	Byte n+2	B5	B4	B3	B2	B1	B0	R5	R4	
RGB 8:8:8	Byte n	B7	B6	B5	B4	B3	B2	B1	B0	16.7M-Color
	Byte n+1	G7	G6	G5	G4	G3	G2	G1	G0	
	Byte n+2	R7	R6	R5	R4	R3	R2	R1	R0	

Figure 6.3.3.2.2 Packed pixel data format

- Pixel Data Attributes – 2 bytes that contain a 16-bit unsigned integer.

  o Bits [1:0] – Select the display where the pixel data must be routed. Set 2’b11 for pixel data is displayed to both eyes. Other value (2’b00, 2’b01, 2’b10) is not support.

  o Bits [15:2] – Not support. Please set to 14’d0

- X Left Edge – 2 bytes that contain a 16-bit unsigned integer that specifies the X coordinate of the left edge of the screen window filled by the Pixel Data field. Please refer to “Example of Video Stream Packet Fields”
- Y Top Edge – 2 bytes that contain a 16-bit unsigned integer that specifies the Y coordinate of the top edge of the screen window filled by the Pixel Data field. Please refer to “Example of Video Stream Packet Fields”

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- X Right Edge – 2 bytes that contain a 16-bit unsigned integer that specifies the X coordinate of the right edge of the window being updated. Please refer to “Example of Video Stream Packet Fields”
- Y Bottom Edge – 2 bytes that contain a 16-bit unsigned integer that specifies the Y coordinate of the bottom edge of the window being updated. Please refer to “Example of Video Stream Packet Fields”
- X Start – 2 bytes that contain a 16-bit unsigned integer that specifies the absolute X coordinate, where the point (X Start, Y Start) is the first pixel in the Pixel Data field below. Please refer to “Example of Video Stream Packet Fields”
- Y Start – 2 bytes that contain a 16-bit unsigned integer that specifies the absolute Y coordinate, where the point (X Start, Y Start) is the first pixel in the Pixel Data field below. Please refer to “Example of Video Stream Packet Fields”
- Pixel Count – 2 bytes that contain a 16-bit unsigned integer that specifies the number of pixels in the Pixel Data field below.
- Parameter CRC – 2 bytes that contain a 16-bit CRC of all bytes from the Packet Length to the Pixel Count. If this CRC fails to check then the entire packet shall be discarded.
- Pixel Data – The raw video information to be displayed. Data is formatted in the manner described by the Video Data Format Descriptor field. If bit 5 of the Pixel Data Attributes field is set to one then the Pixel Data field contains exactly one row of pixels, where the first pixel transmitted corresponds to the leftmost pixel and the last pixel transmitted corresponds to the right-most pixel.
- Pixel Data CRC – 2 bytes that contain a 16-bit CRC of only the Pixel Data. If this CRC fails to check then the Pixel Data may still be used but the CRC error count shall be incremented.

Example of Video Stream Packet Fields

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6.3.3.3. Link shut down packet

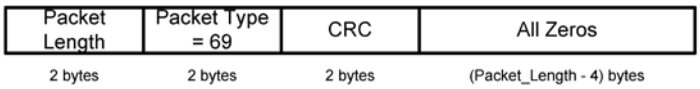

Figure 6.3.3.3.1 Link shut down packet format

The Shutdown Packet is sent from the host to the client to indicate that the MDDI Data and strobe will be shut down and go into a low-power hibernation state. This packet is useful to shut down the link and conserve power after static Image Data are sent from a mobile communication device to the client. Normal operation is resumed when the link is restarted and the host sends packets again. The first packet sent after hibernation is a sub-frame header packet. The Shutdown Packet is required to enable link hibernation. More information about link shutdown and wake-up is provided by some weak up sequence. Every host shall be able to generate this packet, and every client shall be able to receive and interpret this packet.

6.3.3.4. Filler packet

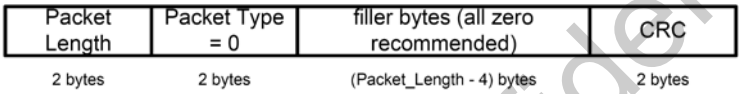

Figure 6.3.3.4.1 Filler packet format

The Filler Packet is sent when no other information is available to be sent on the forward link. It is recommended to send filler packets with minimum length to allow maximum flexibility to send other packets when required. At the very end of a sub-frame encapsulation packet the MDDI link controller shall set the size of the Filler Packet to exactly fill the remaining space to maintain packet integrity. The Filler Packet is required to maintain timing on the link when the host has no information to send. Every host and client shall be able to send and receive this packet.

6.3.3.5. Reverse link encapsulation packet

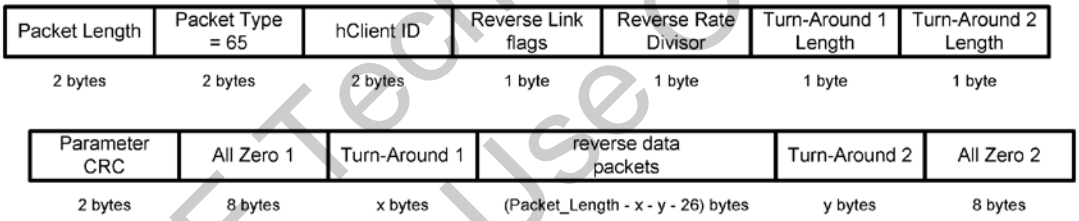

Figure 6.3.3.5.1 Reverse link encapsulation packet format

Data is transferred in the reverse direction using the Reverse Link Encapsulation Packet. A forward link packet is sent and the MDDI link is turned around in the middle of this packet so that packets can be sent in the reverse direction. The MDDI_Stb signal is always driven by the host. The host behaves as if it were transmitting a zero for each bit of the Turn-Around, Driver Re-enable, and Reverse Data Packets fields of the packet. The result is that the MDDI_Stb toggles at each bit boundary of these portions of the packet. The client shall clock new data on certain rising edges of the MDDI strobe as specified in the packet contents description below, and in more detail in section 7. The format of the Reverse Link Encapsulation Packet is illustrated in Figure 6.2.3.5.1. For External Mode every host shall be able to generate this packet and receive data, and every client shall be able to receive and send data to the host. Implementation of this packet is optional for Internal Mode, but the Reverse Link Encapsulation Packet is necessary for the host to receive data from the client.

Packet Contents:

- Packet Length – Specifies the total number of bytes in the packet not including the packet length field.
- Packet Type – A Packet Type of 65=0x0041 identifies the packet as a Reverse Link Encapsulation Packet.
- hClient ID – This field is reserved for future use and shall be set to zero
- Reverse Link Flags – 1 byte that contains an 8-bit unsigned integer that contains a set of flags to request information from the client and specify the reverse link interface type. If a bit is set to one then the host requests the specified information from the client. If the bit is zero then the host does not need the information from the client.
  - o Bit 0 – The host needs the Client Capability Packet.
  - o Bit 1 – The host needs the Client Request and Status Packet.
  - o Bits [7:2] – reserved for future use and shall be set to zero.
- Reverse Rate Divisor – 1 byte that contains an 8-bit unsigned integer that specifies the number of MDDI_Stb cycles that occur per reverse link data clock. The reverse link data clock is equal to the forward link data clock divided by two times the Reverse Rate Divisor.

  The reverse link data rate is related to the reverse link data clock and the Interface Type on the reverse link in the following manner:

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o Interface Type 1 – reverse data rate = reverse link data clock.

o Interface Type 2 – reverse data rate = two times reverse link data clock.

o Interface Type 3 – reverse data rate = four times reverse link data clock.

o Interface Type 4 – reverse data rate = eight times reverse link data clock.

- Turn-Around 1 Length – Specifies the total number of bytes that are allocated for Turn-Around 1.
- Turn-Around 2 Length – Specifies the total number of bytes that are allocated for Turn-Around 2.
- Parameter CRC – Contain a 16-bit CRC of all bytes from the Packet Length to the Turn-Around Length. If this CRC fails to check then the entire packet shall be discarded
- All Zero 1 – 8 bytes that each contain an 8-bit unsigned integer equal to zero. This field ensures that all MDDI_Data signals are at a logic-zero level for a sufficient time to allow the client to begin recovering clock using only MDDI_Stb prior to disabling the host's line drivers during the Turn-Around 1 field.
- Turn-Around 1 – First turn-around period. The number of bytes specified by the Turn-Around 1 Length parameter is allocated to allow the MDDI_Data line drivers in the client to enable before the line drivers in the host are disabled. The client shall enable its MDDI_Data line drivers during bit 0 of Turn-Around 1 and the host shall disable its outputs and be completely disabled prior to the last bit of Turn-Around 1. The MDDI_Stb signal behaves as though MDDI_Data0 were at a logic-zero level during the entire Turn-Around 1 period.
- Reverse Data Packets – A series of data packets transferred from the client to host. The client may send filler packets or drive the MDDI_Data lines to a logic-zero level when it has no data to send to the host. If the MDDI_Data lines are driven to zero the host will interpret this as a packet with a zero length (not a valid length) and the host will accept no additional packets from the client for the duration of the current Reverse Link Encapsulation Packet.
- Turn-Around 2 – The second turn-around period. The number of bytes is specified by the Turn-Around Length parameter. The host shall wait for at least the round trip delay time before it enables its MDDI_Data line drivers during Turn-Around 2. The host shall enable its MDDI_Data line drivers and be completely enabled prior to the last bit of Turn-Around 2 and the client shall disable its outputs and be completely disabled prior to the last bit of Turn-Around 2. The purpose of Turn-Around 2 is to allow the remaining amount of data from the Reverse Data Packets field to be transmitted from the client. Due to variations in different systems and the amount of safety margin allocated it is possible that neither the host nor client will be driving the MDDI_Data signals to a logic-zero level during some parts of the Turn-Around 2 field as seen by the line receivers at the host. The MDDI_Stb signal behaves as though MDDI_Data0 were at a logic-zero level during the entire Turn-Around 2 period.
- All Zero 2 – 8 bytes that each contains an 8-bit unsigned integer equal to zero. This field ensures that all MDDI_Data signals are at a logic-zero level for a sufficient time to allow the client to begin recovering clock using both MDDI_Data0 and MDDI_Stb after enabling the host's line drivers following the Turn-Around 2 field.

6.3.3.6. Round-trip delay measurement packet

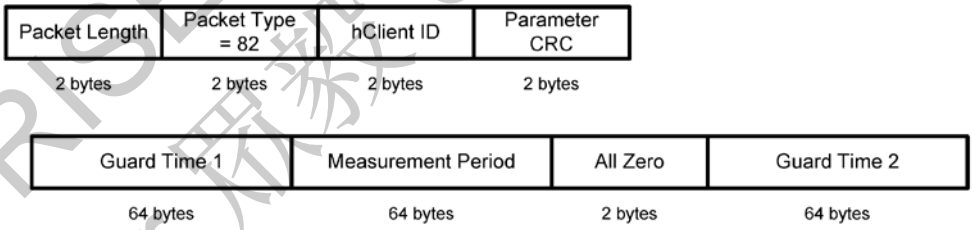

Figure 6.3.3.6.1 Round-trip delay measurement packet format

The Round-Trip Delay Measurement Packet is used to measure the propagation delay from the host to the client plus the delay from the client back to the host. This measurement inherently includes all of the delays that exist in the line drivers and receivers and the interconnect subsystem. This measurement is used to set the turn around delay and reverse link rate divisor parameters in the Reverse Link Encapsulation Packet. This packet is most useful when the MDDI link is running at the maximum speed intended for a particular application. The packet may be sent in Type I mode and at a lower data rate to increase the range of the Round-Trip delay measurement.

Packet Contents:

- Packet Length – Specifies the total number of bytes in the packet not including the packet length field. The Packet Length is always 200.
- Packet Type – A Packet Type of 82=0x0052 identifies the packet as a Round-Trip Delay Measurement Packet.
- hClient ID – This field is reserved for future use and shall be set to zero.
- Parameter CRC – Contain a 16-bit CRC of all bytes from the Packet Length to the Packet Type. If this CRC fails to check then the entire packet shall be discarded.
- Guard Time 1 – 64 bytes to allow the MDDI_Data line drivers in the client to enable before the line drivers in the host are disabled. The client shall enable its MDDI_Data line drivers during bit 0 of Guard Time 1 and the host shall disable its line drivers and be completely disabled prior to the last bit of Guard Time 1. The host and client shall both drive a logic zero level during Guard Time 1 when they are not

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disabled. Another purpose of this field is to ensure that all MDDI_Data signals are at a logic-zero level for a sufficient time to allow the client to begin recovering clock using only MDDI_Stb prior to disabling the host's line drivers.

- Measurement Period – a 64 byte window to allow the client to respond with two bytes of 0xff and 30 bytes of 0x00 at half the data rate used on the forward link. This rate corresponds to a Reverse Link Rate Divisor of 1. The client returns this response immediately at the time it perceives as the beginning of the Measurement Period. This response from the client will be received at the host at precisely the round trip delay of the link plus logic delay in the client after the beginning of the first bit of the Measurement Period at the host.
- All Zero – 2 bytes that each contains an 8-bit unsigned integer equal to zero. This field allows the MDDI_Data line drivers in the host and client to overlap so that MDDI_Data is always driven. The host shall enable its MDDI_Data line drivers during bit 0 of the All Zero field, and the client shall also continue to drive the signal to a logic-zero level as it did at the end of the Measurement Period.

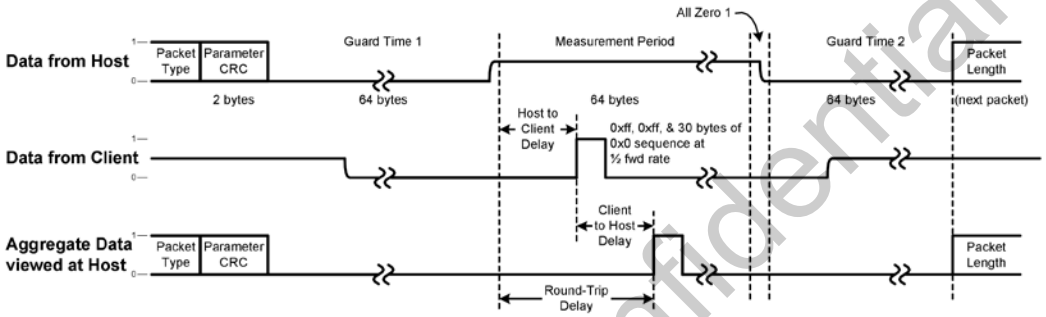

Figure 6.3.3.6.2 Round-trip delay measurement timing

Figure 6.2.3.6.2 illustrates the timing of events during the Round-Trip Delay Measurement Packet. The host transmits the Round-Trip Delay Measurement Packet and a delay is incurred before the packet reaches the client. As the client receives the packet it transmits the 0xff, 0xff, and 30 bytes of 0x00 pattern precisely at the beginning of the Measurement Period as detected by the client. The actual time the client begins to transmit this sequence is delayed from the beginning of the Measurement Period when viewed at the host. The amount of this delay is precisely the time it takes for the packet to propagate down the cable, through the line receivers and drivers in the client, and back through the cable to the host.

The host shall count the number of forward-link bit times from the start of the Measurement Period to the beginning of the 0xff, 0xff, and 30 bytes of 0x00 sequence. When a Type 2 – 4 reverse link is being used the host shall measure and save the round-trip delay value of all MDDI_Data pairs in case the data rate and round-trip delay skew are large enough to affect the arrival time if each bit differently.

The host and client both drive the line to a logic-zero level during both guard times to keep the MDDI_Data lines in a defined state. The enable and disable times of the host and client during both guard times are such that the MDDI_Data signals are always at a valid low for any valid round-trip delay time.

6.3.3.7. Register access packet

Packet Length	Packet Type = 146	bClient ID	Read/Write Info	Register Address	Parameter CRC	Register Data List	Register Data CRC
2 bytes	2 bytes	2 bytes	2 bytes	4 bytes	2 bytes	Packet Length - 14 bytes	2 bytes

Figure 6.3.3.7.1 Register access packet format

The Register Access Packet provides either the host or client with a means to access configuration and status registers in the opposite end of the MDDI link. The registers are likely to be unique for each display or device controller. These registers already exist in many displays that require setting configurations, modes of operation, and other useful and necessary settings. The Register Access Packet allows the MDDI host or client to both write to a register and request to read a register via the MDDI link. When the host or client requests to read a register, the opposite end shall respond by sending the register data in the same packet type but indicating that this is the data read from a particular register with the use of the Read/Write Info field. The Register Access Packet may be used to read or write multiple registers by specifying a register count greater than 1.The client shall indicate its ability to support the Register Access Packet via bit 22 of Client Feature Capability Indicators field of the Client Capability Packet.

Packet Contents:

- Packet Length – Specifies the total number of bytes in the packet not including the packet length field.
- Packet Type – A Packet Type of 146=0x0092 identifies the packet as a Register Access Packet.
- bClient ID – This field is reserved for future use and shall be set to zero.
- Read/Write Info – Specifies the packet as either a write, or a read, or a response to a read, and provides a count of the data values.
  - o Bits [15:14] – Read/Write Flags
  - o Bits [13:0] – a 14-bit unsigned integer that specifies the number of 32-bit Register Data List items to be transferred in the Register Data List field.

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- o If bits [15:14] equal 00 then bits [13:0] specify the number of 32-bit register data items that are contained in the Register Data List field to be written to registers starting at the register specified by the Register Address field.
- o If bits [15:14] equal 10 then bits [13:0] specify the number of 32-bit register data items that the receiving device shall send to the device requesting that the registers be read. The Register Data List field in this packet shall contain no items and is of zero length.
- o If bits [15:14] equal 11 then bits [13:0] specify the number of 32-bit register data items that have been read from registers that are contained in the Register Data List field.
- o Bits [15:14] shall not be equal to 01. This is not a valid value and is reserved for future use.

• Register Address – Contains the register address that is to be written to or read from. For addressing registers whose addressing is less than 32 bits, the upper bits shall be set to zero.

• Parameter CRC – 2 bytes that contain a 16-bit CRC of all bytes from the Packet Length to the Register Address. If this CRC fails to check then the entire packet shall be discarded.

• Register Data List – a list of 4-byte register data values to be written to client registers or values that were read from client device registers.

• Register Data CRC – 2 bytes that contain a 16-bit CRC of only the Register Data List. If this CRC fails to check then the Register Data may still be used but the CRC error count shall be incremented.

6.3.3.8. Client request and status packet

Packet Length	Packet Type = 70	cClient ID	Reverse Link Request	CRC Error Count	Client Status	Client Busy Flags	CRC
2 bytes	2 bytes	2 bytes	2 bytes	1 byte	1 byte	2 bytes	2 bytes

Figure 6.3.3.8.1 Client request and status packet format

The host needs a small amount of information from the client so it can configure the host-to-client link in an optimum manner. It is recommended that the client send one Client Request and Status Packet to the host each sub-frame. It is recommended that the client send this packet as the first packet in the Reverse Link Encapsulation Packet to ensure that it is delivered reliably to the host, and it is required when requested by the host via the Reverse Link Flags in the Reverse Link Encapsulation Packet. The Client Request and Status Packet is required to report errors and status to the host. For external mode every host shall be able to receive this packet, and every client shall be able to send this packet. It is highly recommended that internal mode hosts and clients also support this packet, but it is not required.

Packet Contents:

• Packet Length – Specifies the total number of bytes in the packet not including the packet length field. The Packet Length is always 12.

• Packet Type – A Packet Type of 70=0x0046 identifies the packet as a Client Request and Status Packet.

• cClient ID – This field is reserved for future use and shall be set to zero.

• Reverse Link Request – Specifies the number of bytes the client needs in the reverse link in the next sub-frame to send information to the host.

• CRC Error Count – Indicates the number of CRC errors that have occurred since the last Client Request and Status Packet was sent by the client. The CRC count is reset each time a Client Request and Status Packet is sent. If the actual number of CRC errors exceeds 255 then this value saturates at 255.

• Client Status – Contains a group of flags that indicate the current status of the client device.

- o Bit 0 – Indicates that there has been a change in the capability of the client. This could be due to the user connecting a peripheral device such as a microphone, keyboard, or display, or some other reason.
  - Bit 0 = 1 – capability has changed. Examine the Client Capability Packet to determine the new client characteristics.
  - Bit 0 = 0 – capability has not changed since the last Client Capability Packet was sent.
- o Bit 1 – Indicates that the client device has detected an error in processing a packet since the last Client Capability Packet was sent. Implementation of this bit is optional in the client device. Additional information about the error may be provided via other means, such as the Client Error Report Packet or via a Register Access Packet.
- o Bits [7:2] – reserved for future use and shall be set to zero.

• Client Busy Flags – Indicate that the client is performing a specific function and is not ready to accept another packet related to that function. A bit set to one indicates that the particular function is currently being performed by the client and that the related function in the client is busy. If the related function in the client is ready the bit shall be zero. The client shall always return a busy status (bit set to one) for all functions that are not supported in the client.

- o Bit 0 – bitmap block transfer function is busy.
- o Bit 1 – bitmap area fill function is busy.

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o Bit 2 – bitmap pattern fill function is busy.

o Bit 3 – the graphics subsystem is busy performing an operation that requires use of the frame buffer in the client. Other graphics functions that require use of the frame buffer may not begin until this bit is set to one.

o Bits [15:4] – reserved for future use and shall be set to one to indicate busy status in case these bits are assigned in a future version of this standard.

• CRC – 2 bytes that contain a 16-bit CRC of all bytes in the packet including the Packet Length.

6.3.3.9. Client capability packet

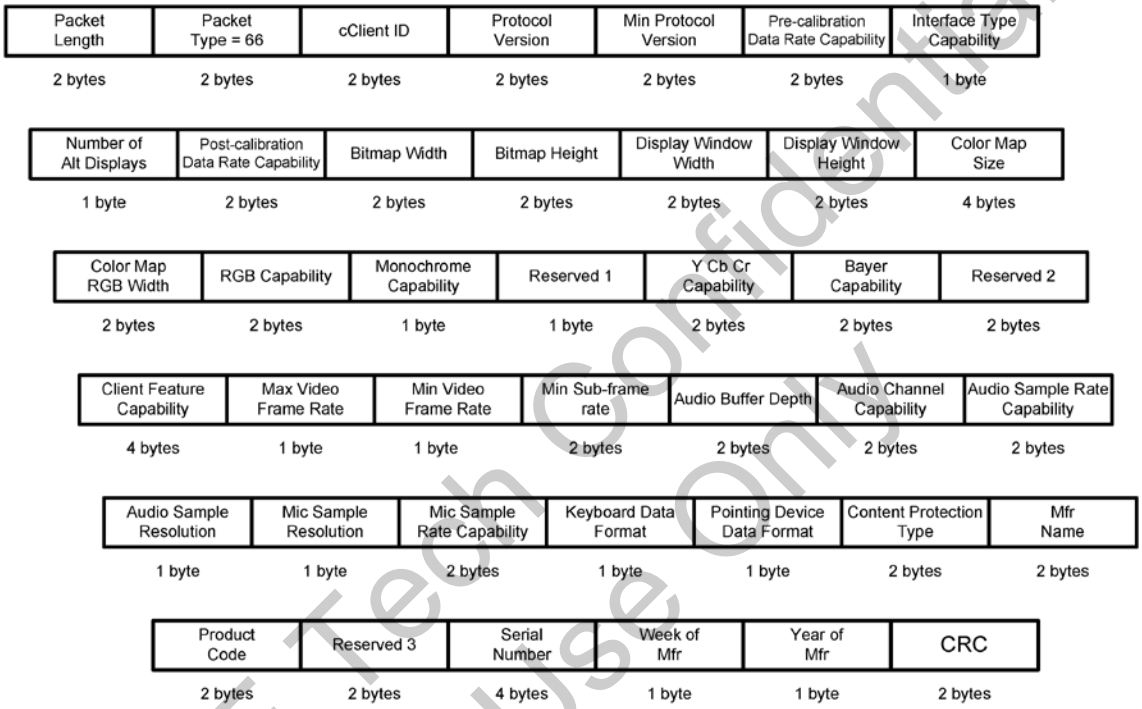

Figure 6.3.3.9.1 Client capability packet format

The host needs to know the capability of the client so it can configure the host-to-client link in an optimum manner. It is recommended that the client send a Client Capability Packet to the host after forward link synchronization is acquired, and it is required when requested by the host via the Reverse Link Flags in the Reverse Link Encapsulation Packet. The Client Capability Packet is required to inform the host of the capabilities of the client. For External Mode every host shall be able to receive this packet, and every client shall be able to send this packet. Implementation of this packet is optional for Internal Mode.

Packet Contents:

• Packet Length – Specifies the total number of bytes in the packet not including the packet length field.

• Packet Type – A Packet Type of 66=0x0042 identifies the packet as a Client Capability Packet.

• cClient ID –This field is reserved for future use and shall be set to zero.

• Protocol Version – Specifies the protocol version used by the client. The present protocol version shall be set to 2.

• Minimum Protocol Version – Specifies the minimum protocol version that the client can interpret. Zero is an invalid value.

• Pre-Calibration Data Rate Capability – Specifies the maximum data rate the client can receive on each data pair on the forward MDDI link prior to performing forward link skew calibration. The rate is specified as the number of million bits per second (Mbps).

• Interface Type Capability – Specifies the interface types that are supported on the forward and reverse links. A bit set to 1 indicates that the specified interface type is supported, and a bit set to 0 indicates that the specified type is not supported. All hosts and clients shall support at least Type 1 on the forward and reverse link. It is not required to support a contiguous range of interface types. For example, it is valid to support only Type 1 and Type 3, and not Type 2 and Type 4. The forward and reverse links are not required to operate with the same interface type except when the link comes out of hibernation where both forward and reverse shall operate in Type 1 mode.

o Bit 0 – Client can function in Type 2 (2-bit) mode on the forward link.

o Bit 1 – Client can function in Type 3 (4-bit) mode on the forward link.

o Bit 2 – Client can function in Type 4 (8-bit) mode on the forward link.

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  - o Bit 3 – Client can function in Type 2 (2-bit) mode on the reverse link.
  - o Bit 4 – Client can function in Type 3 (4-bit) mode on the reverse link.
  - o Bit 5 – Client can function in Type 4 (8-bit) mode on the reverse link.
  - o Bits [7:6] are reserved and shall be set to zero.

- Number of Alt Displays – Specifies the number of alternate displays supported by the MDDI client. This value is zero in OTM8009A.
- Post-Calibration Data Rate Capability – Specifies the maximum data rate the client can receive on each data pair on the forward MDDI link after performing forward link skew calibration. The rate is specified as the number of million bits per second (Mbps). If the client device does not support the Forward Link Skew Calibration Packet then this field shall be set to zero.
- Bitmap Width – Specifies the width of the bitmap expressed as a number of pixels.
- Bitmap Height – Specifies the height of the bitmap expressed as a number of pixels.
- Display Window Width – Specifies the width of the display window expressed as a number of pixels. Often this will have the same value as the Bitmap Width.
- Display Window Height – Specifies the height of the display window expressed as a number of pixels. Often this will have the same value as the Bitmap Height.
- Color Map Size – Specifies the maximum number of table items that exist in the color map table in the client. OTM8009A cannot use the color map format then this value is zero.
- Color Map RGB Width – Specifies the number of bits of the red, green, and blue color components that can be displayed in the color map (palette) display mode. OTM8009A cannot use the color map (palette) format then this value is zero.
- RGB Capability – Specifies the number of bits of resolution that can be displayed in RGB format. If the client cannot use the RGB format then this value is zero. The RGB Capability word is composed of three separate unsigned values:
  - o Bits [3:0] define the maximum number of bits of blue (the blue intensity) in each pixel.
  - o Bits [7:4] define the maximum number of bits of green (the green intensity) in each pixel.
  - o Bits [11:8] define the maximum number of bits of red (the red intensity) in each pixel.
  - o Bits [13:12] are reserved for future use and shall be set to zero.
  - o Bit 14 is equal to zero this indicates that the client cannot accept RGB pixel data in unpacked format.
  - o Bit 15 when set to one indicates that the client can accept RGB pixel data in packed format. If bit 15 is equal to zero this indicates that the client cannot accept RGB pixel data in packed format.
- Monochrome Capability –Specifies the parameter of monochrome format. OTM8009A cannot use this format then the value is zero.
- Reserved 1 – 1 byte that contains an 8-bit unsigned integer that is reserved for future use. All bits in this field shall be set to zero.
- Y Cb Cr Capability – Specifies the parameter of Y Cb Cr format. OTM8009A cannot use the Y Cb Cr format then this value is zero.
- Bayer Capability – Specifies the parameter of Bayer format. OTM8009A cannot use the Bayer format then this value is zero.
- Reserved 2 – 2 bytes that contain a 16-bit unsigned integer that is reserved for future use. All bits in this field shall be set to zero.
- Client Feature Capability Indicators – Contains a set of flags that indicate the whether specific features in the client are supported.

  A bit set to one indicates the capability is supported, and a bit set to zero indicates the capability is not supported.
  - o Bit 0 – the Bitmap Block Transfer Packet (packet type 71) is supported
  - o Bit 1 – the Bitmap Area Fill Packet (packet type 72) is supported.
  - o Bit 2 – the Bitmap Pattern Fill Packet (packet type 73) is supported.
  - o Bit 3 – the Read Frame Buffer Packet (packet type 74) is supported.
  - o Bit 4 – the client has the capability to support the Transparent Color and Mask Setup Packet.
  - o Bit 5 – the client can accept audio data in unpacked format.
  - o Bit 6 – the client can accept audio data in packed format.
  - o Bit 7 – the client can send a reverse-link video stream from a camera.
  - o Bit 8 – the client has the ability to receive a full line of pixel data.
  - o Bit 9 – the client has the ability to respond to the Display Power State Packet.
  - o Bit 10 – the client has the ability to support display power state 01.

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- Bit 11 – the client is communicating with a pointing device and can send and receive Pointing Device Data Packets.
- Bit 12 – the client is communicating with a keyboard and can send and receive Keyboard Data Packets.
- Bit 13 – the client has the ability to set one or more audio or video parameters by supporting the VCP Feature packets.
- Bit 14 – the client has the ability to write pixel data into the offline display frame buffer.
- Bit 15 – the client has the ability to write pixel data into only the display frame buffer currently being used to refresh the display image.
- Bit 16 – the client has the ability to write pixel data from a single Video Stream Packet into all display frame buffers.
- Bit 17 – the client has the ability to respond to the Request Specific Status Packet.
- Bit 18 – the client has the ability to respond to the Round-Trip Delay Measurement Packet.
- Bit 19 – the client has the ability to respond to the Forward Link Skew Calibration Packet.
- Bit 20 – the client has the ability to interpret the Request Specific Status Packet and respond with the Valid Status Reply List Packet.
- Bit 21 – the client has the ability to use the Raster Operation field of the Bitmap Block Transfer Packet (packet type 71).
- Bit 22 – the client has the ability to respond to the Register Access Packet
- Bits [31:23] – reserved for future use, shall be set to zero.

• Maximum Video Frame Rate Capability – Specifies the maximum video frame update capability of the client in frames per second. The host may choose to update the image at a rate less than or equal to the value specified in this field.

• Minimum Video Frame Rate Capability – Specifies the minimum video frame update capability of the client in frames per second.

• Minimum Sub-frame Rate – Specifies the minimum sub-frame rate in frames per second.

• Audio Buffer Depth – OTM8009A can not support Audio function then this value is zero.

• Audio Channel Capability – OTM8009A can not support Audio function then this value is zero.

• Audio Sample Rate Capability (forward link) – OTM8009A can not support Audio function then this value is zero.

• Audio Sample Resolution (forward link) – OTM8009A can not support Audio function then this value is zero.

• Mic Audio Sample Resolution (reverse link) – OTM8009A can not support Audio function then this value is zero.

• Mic Sample Rate Capability (reverse link) – OTM8009A can not support Audio function then this value is zero.

• Keyboard Data Format – OTM8009A can not support Audio function then this value is zero.

• Pointing Device Data Format – OTM8009A can not support Audio function then this value is zero.

• Content Protection Type – OTM8009A can not support Audio function then this value is zero.

• Mfr Name – 2 bytes that form a 16-bit value that contains the EISA 3-character ID of the manufacturer, packed into three 5-bit characters in the same manner as in the VESA EDID specification. The character ‘A’ is represented as 00001 binary, the character ‘Z’ is represented as 11010 binary, and all letters between ‘A’ and ‘Z’ are represented as sequential binary values that correspond to the alphabetic sequence between ‘A’ and ‘Z’. The most significant bit of the Mfr Name field is unused and shall always be zero. Example: a manufacturer represented by the string “XYZ” would have a Mfr Name value of 0x633a. If this field is not supported by the client it shall be set to zero.

• Product Code – 2 bytes that contain a 16-bit unsigned integer that contains a product code assigned by the display manufacturer. If this field is not supported by the client it shall be set to zero.

• Reserved 3 – 2 bytes that contain a 16-bit unsigned integer that is reserved for future use.

• Serial Number – 4 bytes that contain a 32-bit unsigned integer that specifies the serial number of the display in numeric form. If this field is not supported by the client it shall be set to zero.

• Week of Manufacture – 1 byte that contains an 8-bit unsigned integer that defines the week of manufacture of the display. This value shall be in the range of 1 to 53 if it is supported by the client. If this field is not supported by the client it shall be set to zero.

• Year of Manufacture – 1 byte that contains an 8-bit unsigned integer that defines the year of manufacture of the display. This value is an offset from the year 1990. Years in the range of 1991 to 2245 can be expressed by this field. Example: the year 2003 corresponds to a Year of Manufacture value of 13. If this field is not supported by the client it shall be set to zero.

• CRC – 2 bytes that contain a 16-bit CRC of all bytes in the packet including the Packet Length.

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6.3.4. Hibernation / wake-up

6.3.4.1. Hibernation state

This IC support hibernation mode to save interface power consumption. MDDI link can enter the hibernation state quickly and wake up from hibernation quickly. This allows the system to force MDDI link into hibernation frequently to save power consumption.

During hibernation mode, the hi-speed transmitters and receivers are disabled and the low-speed & low-power receivers are enabled in order to detect wake-up sequence.

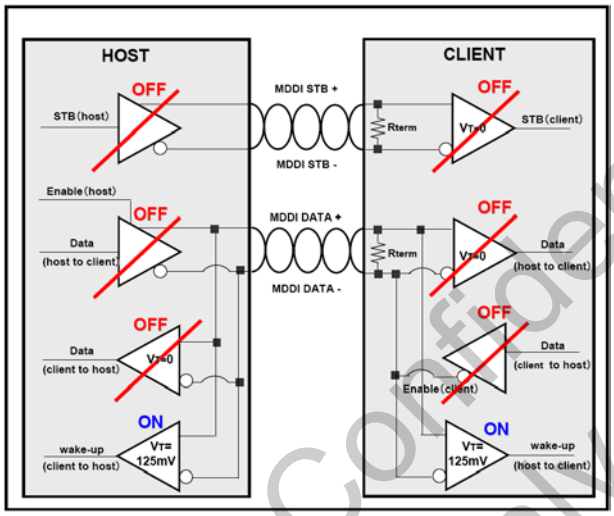


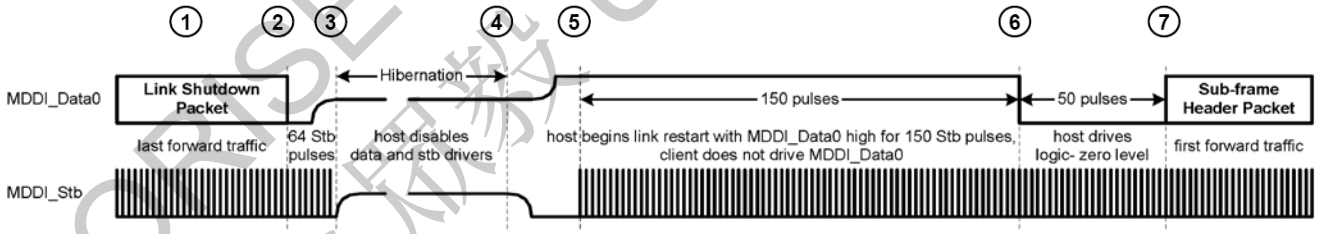
Figure 6.3.4.1.1 MDDI transceiver / receiver state in hibernation

When the link wakes up from hibernation, the host and client exchange a sequence of pulses. These pulses can be detected using low-speed, low-power receivers that consume only a fraction of the current of the differential receivers required to receive the signals at the maximum link operating speed.

Either the client or the host can wake up the link; Host-initiated link wakeup and Client-initiated link wakeup.

6.3.4.2. Host-Initiated wake-up from Hibernation

A. Host-initiated Link Wake-up Procedure The simple case of a host-initiated wake-up is described below without contention from the client trying to wake up at the same time. The following sequence of events is illustrated in the following figure.



The Detailed descriptions for labeled events are as follows:

①. The host sends a Link Shutdown Packet to inform the client that the link will transition to the low- power hibernation state.

②. Following the CRC of the Link Shutdown Packet the host toggles MDDI_Stb for 64 cycles to allow processing in the client to finish before it stops MDDI_Stb from toggling which stops the recovered clock in the client device. Also during this interval the host initially sets MDDI_Data to a logic-zero level, and then disables the MDDI_Data output in the range of 16 to 48 MDDI_Stb cycles (including output disable propagation delays) after the CRC. It may be desirable for the client to place its high-speed receivers for MDDI_Data and MDDI_Stb into a low power state any time after 48 MDDI_Stb cycles after the CRC and before point 3.

③. The host enters the low-power hibernation state by disabling the MDDI_Data and MDDI_Stb drivers and by placing the host controller into a low-power hibernation state. It is also allowable for MDDI_Stb to be driven to logic-zero level or to continue toggling during hibernation. The client is also in the low-power hibernation state.

④. After a while, the host begins the link restart sequence by enabling the MDDI_Data and MDDI_Stb driver outputs. The host drives MDDI_Data to a logic-one level and MDDI_Stb to logic- zero level for at least the time it takes for the drivers to fully enable their outputs. The host shall wait at least 200n sec after MDDI_Data reaches a valid logic-one level and MDDI_Stb reaches a valid logic-zero level before driving pulses on MDDI_Stb. This gives the client sufficient time to prepare to receive high-speed pulses on MDDI_Stb. The client first detects the wake-up pulse using a low-power differential receiver having a +125mV input offset voltage.

⑤. The host drivers are fully enabled and MDDI_Data is being driven to a logic-one level. The host begins to toggle MDDI_Stb in a manner consistent with having logic-zero level on MDDI_Data for duration of 150 MDDI_Stb cycles.

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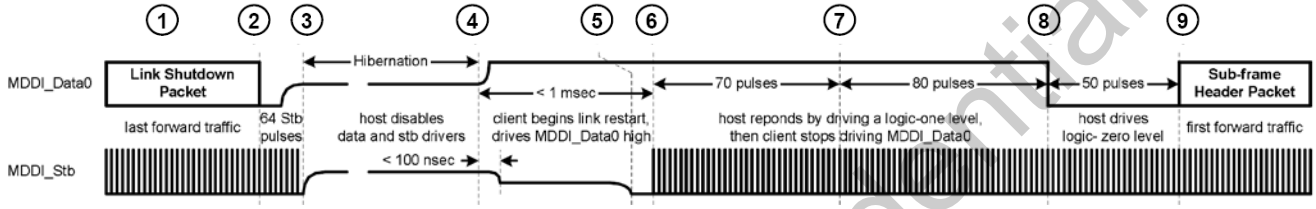
⑥. The host drives MDDI_Data to logic-zero level for 50 MDDI_Stb cycles. The client begins to look for the Sub-frame Header Packet after MDDI_Data is at logic-zero level for 40 MDDI_Stb cycles.

⑦. The host begins to transmit data on the forward link by sending a Sub-frame Header Packet. Beginning at point 7. The MDDI host generates MDDI_Stb based on the logic level on MDDI_Data so that proper data-strobe encoding commences from point 7.

6.3.4.3. Client-Initiated wake-up from Hibernation

B. Client-initiated Link Wake-up Procedure An example of a typical client-initiated service request event with no contention is illustrated in the following figure



The Detailed descriptions for labeled events are as follows:

①. The host sends a Link Shutdown Packet to inform the client that the link will transition to the low-power hibernation state.

②. Following the CRC of the Link Shutdown Packet the host toggles MDDI_Stb for 64 cycles to allow processing in the client to finish before it stops MDDI_Stb from toggling which stops the recovered clock in the client device. Also during this interval the host initially sets MDDI_Data to a logic-zero level, and then disables the MDDI_Data output in the range of 16 to 48 MDDI_Stb cycles (including output disable propagation delays) after the CRC. It may be desirable for the client to place its high-speed receivers for MDDI_Data and MDDI_Stb into a low power state any time after 48 MDDI_Stb cycles after the CRC and before point 3.

③. The host enters the low-power hibernation state by disabling its MDDI_Data and MDDI_Stb driver outputs. It is also allowable for MDDI_Stb to be driven to logic-zero level or to continue toggling during hibernation. The client is also in the low-power hibernation state.

④. After a while, the client begins the link restart sequence by enabling the MDDI_Stb receiver and also enabling an offset in its MDDI_Stb receiver to guarantee the state of the received version of MDDI_Stb is a logical-zero level in the client before the host enables its MDDI_Stb driver. The client will need to enable the offset in MDDI_Stb immediately before enabling its MDDI_Stb receiver to ensure that the MDDI_Stb receiver in the client is always receiving a valid differential signal and to prevent erroneous received signals from propagating into the client. After that, the client enables its MDDI_Data driver while driving MDDI_Data to a logic-one level. It is allowed for MDDI_Data and MDDI_Stb to be enabled simultaneously if the time to enable the offset and enable the standard MDDI_Stb differential receiver is less than 200n sec.

⑤. Within 1m sec the host recognizes the service request pulse (TE), and the host begins the link restart sequence by enabling the MDDI_Data and MDDI_Stb driver outputs. The host drives MDDI_Data to a logic-one level and MDDI_Stb to a logical-zero level for at least the time it takes for the drivers to fully enable their outputs. The host shall wait at least 200n sec after MDDI_Data reaches a valid logic-one level and MDDI_Stb reaches a valid fully- driven logic-zero level before driving pulses on MDDI_Stb. This gives the client sufficient time to prepare to receive high-speed pulses on MDDI_Stb.

⑥. The host begins outputting pulses on MDDI_Stb and shall keep MDDI_Data at a logic-one level for a total duration of 150 MDDI_Stb pulses through point 8. The host generates MDDI_Stb in a manner consistent with sending a logical-zero level on MDDI_Data. When the client recognizes the first pulse on MDDI_Stb it shall disable the offset in its MDDI_Stb receiver.

⑦. The client continues to drive MDDI_Data to a logic-one level for 70 MDDI_Stb pulses, and the client disables its MDDI_Data driver at point 7. The host continues to drive MDDI_Data to a logic-one level for duration of 80 additional MDDI_Stb pulses, and at point 8 drives MDDI_Data to logic-zero level.

⑧. The host drives MDDI_Data to logic-zero level for 50 MDDI_Stb cycles. The client begins to look for the Sub- frame Header Packet after MDDI_Data is at logic-zero level for 40 MDDI_Stb cycles.

⑨. After asserting MDDI_Data to logic-zero level and driving MDDI_Stb for duration of 50 MDDI_Stb pulses the host begins to transmit data on the forward link at point 9 by sending a Sub-frame Header Packet. The client begins to look for the Sub-frame Header Packet after MDDI_Data is at logic-zero level for 40 MDDI_Stb cycles.

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6.3.5. MDDI interface power on/off sequence

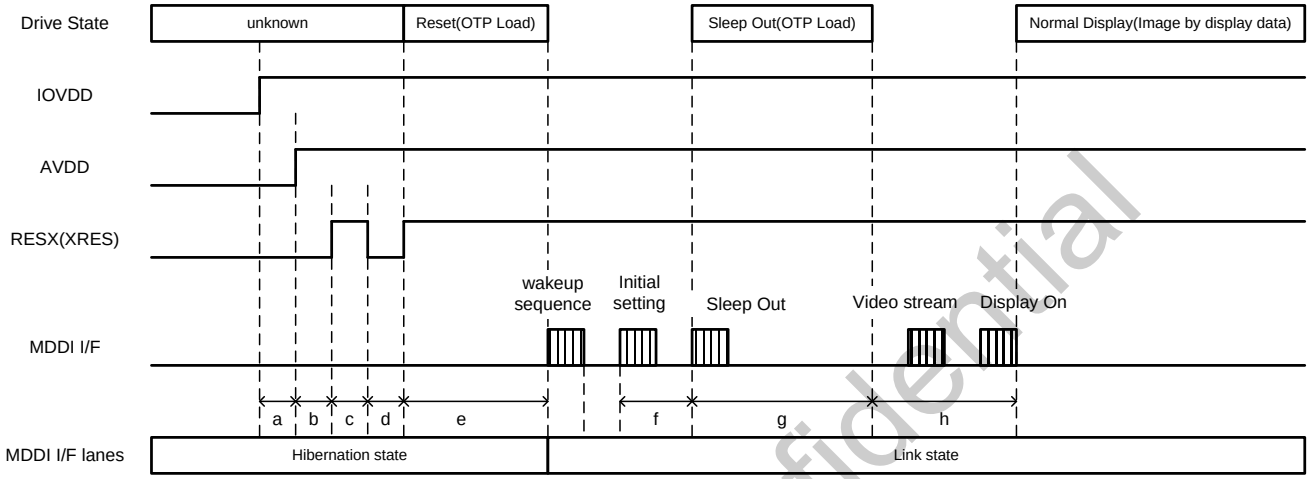

Figure 6.3.51 MDDI interface Power on and shutdown recovery sequence.

Table 6.3.5.1 Power on sequence

Step	Reg	Data	Delay	command	term
1	Initial condition			XRES = L	
2	Power Supply IOVDD			IOVDD ON	
3			Min. 0ms – Max. 10ms		a
4	Power Supply AVDD			AVDD ON	
5			Min. 10ms	Wait until power stable	b
6	RESX go Hi			XRES = H	
7			Min. 10ms		c
8	RESX go Low			XRES = L	
9			Min. 10ms		d
10	RESX go Hi			XRES = H	
11			Min. 20ms	OTP Load	e
12				Host Wake up	
13	Initial setting(Note1)			TE, PWM and other settings(user settings)	f
	xxh	xxh			
14	11h	-		Sleep Out(Note2)	g
15			Min. 120ms		
16				Image Write(Send Video Stream Packet) (Note1)	h
17	29h	-		Display On	

Note1: If you need the other register setting.

Note2: DSI Video signals should be send for 2 frames before Sleep Out command.

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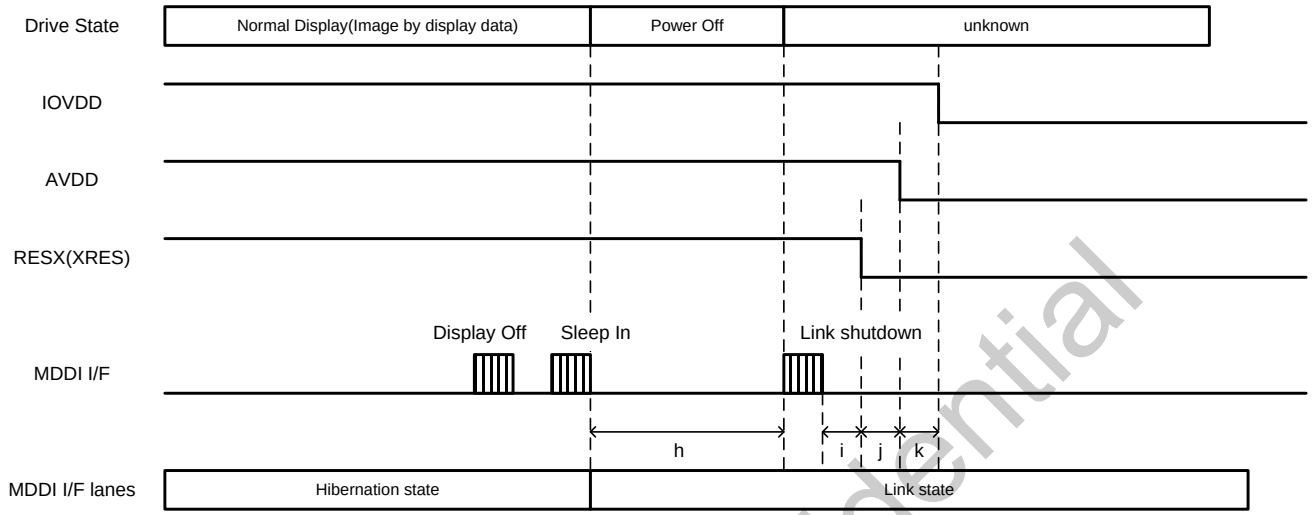

Figure 6.3.5.2 MDDI interface Power off and shutdown recovery sequence.

Table 6.3.5.2 Power off sequence

Step	Reg	Data	Delay	command	term
1	28h	-		Display off	
2	10h	-		Sleep In(*Note3)	
3			Min. 100ms	Power Off	h
4			Min. 0ms		i
5				XRES = L	
6			Min. 10ms		j
7	Power OFF			AVDD OFF	
			Min. 0ms – Max. 10ms		k
				IOVDD OFF	

Note3 : DSI Video signals should be send for 2 frames after Sleep In command.

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6.4. RGB Interface

The OTM8009A support RGB interface Mode 1 and Mode 2. The interface signals as shown in table 6.4.1.

The Mode 1 and Mode 2 function is select by setting in the Command 2, please reference application note.

In RGB Mode 1, writing data to line buffer is done by PCLK and Video Data Bus (D[23:0]), when DE is high state. The external clocks (PCLK, VS and HS) are used for internal displaying clock. So, controller must always transfer PCLK, VS and HS signal to OTM8009A.

In RGB Mode 2, back porch of Vsync is defined by VBP[5:0] of RGBPRCTR command. And back porch of Hsync is defined by HBP[5:0] of RGBPRCTR command. Front porch of Vsync is defined by VFP[5:0] of RGBPRCTR command. And front porch of Hsync is defined by HFP[5:0] of RGBPRCTR command.

RGB I/F Mode	PCLK	DE	VS	HS	DB[23:0]	Register for Blanking Porch setting (Register 0x3Bh, 2nd~5th Parameters)
RGB Mode 1	Used	Used	Used	Used	Used	Not Used
RGB Mode 2	Used	Not Used	Used	Used	Used	Used

Symbol	name	Description
PCLK	Pixel clock	Pixel clock for capturing pixels at display interface
HS	Horizontal sync	Horizontal synchrohnization timing signal
VS	Vertical sync	Vertical synchronization timing signal
DE	Data enable	Data enable signal (assertion indicates valid pixels)
D[23:0],	Pixel data	Pixel data in 16-bit, 18-bit and 24-bit format

Table 6.4.1 The interface signals of RGB interface

6.4.1. RGB interface color mapping Format

The OTM8009A implement a 16-bit, 18-bit and 24 bit pixel-data bus width. The selection of this pixel-data bus width is VIPF [3:0] in the command (3Ah). The interface color mapping of RGB interface are given in Table 6.4.1.1

Table 6.4.1.1 The interface color mapping of DPI interface

Pad name	24 bits configuration VIPF[3:0] = 0111	18 bits configuration VIPF[3:0] = 0110	16 bits configuration VIPF[3:0] = 0101
D23	R7	Not used	Not used
D22	R6	Not used	Not used
D21	R5	Not used	Not used
D20	R4	Not used	R4
D19	R3	Not used	R3
D18	R2	Not used	R2
D17	R1	R5	R1
D16	R0	R4	R0
D15	G7	R3	Not used
D14	G6	R2	Not used
D13	G5	R1	G5
D12	G4	R0	G4
D11	G3	G5	G3
D10	G2	G4	G2
D9	G1	G3	G1
D8	G0	G2	G0
D7	B7	G1	Not used
D6	B6	G0	Not used
D5	B5	B5	Not used
D4	B4	B4	B4
D3	B3	B3	B3
D2	B2	B2	B2
D1	B1	B1	B1
D0	B0	B0	B0

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6.4.2. RGB timing parameter

In the RGB interface, the frame is transmitted from the host processor to a display module as a sequence of pixels, with each horizontal line of the image data sent as a group of consecutive pixels.

Vsync (VS) indicates the beginning of each frame of the displayed image.

Hsync (HS) signals the beginning of each horizontal line of pixels.

Each pixel value (16-, 18-, or 24-bit data) is transferred from the host processor to the display module during one pixel period. The rising edge of PCLK is used by the display module to capture pixel data.

Since PCLK runs continuously, control signal DE is required to indicate when valid pixel data is being transmitted on the pixel data signals.

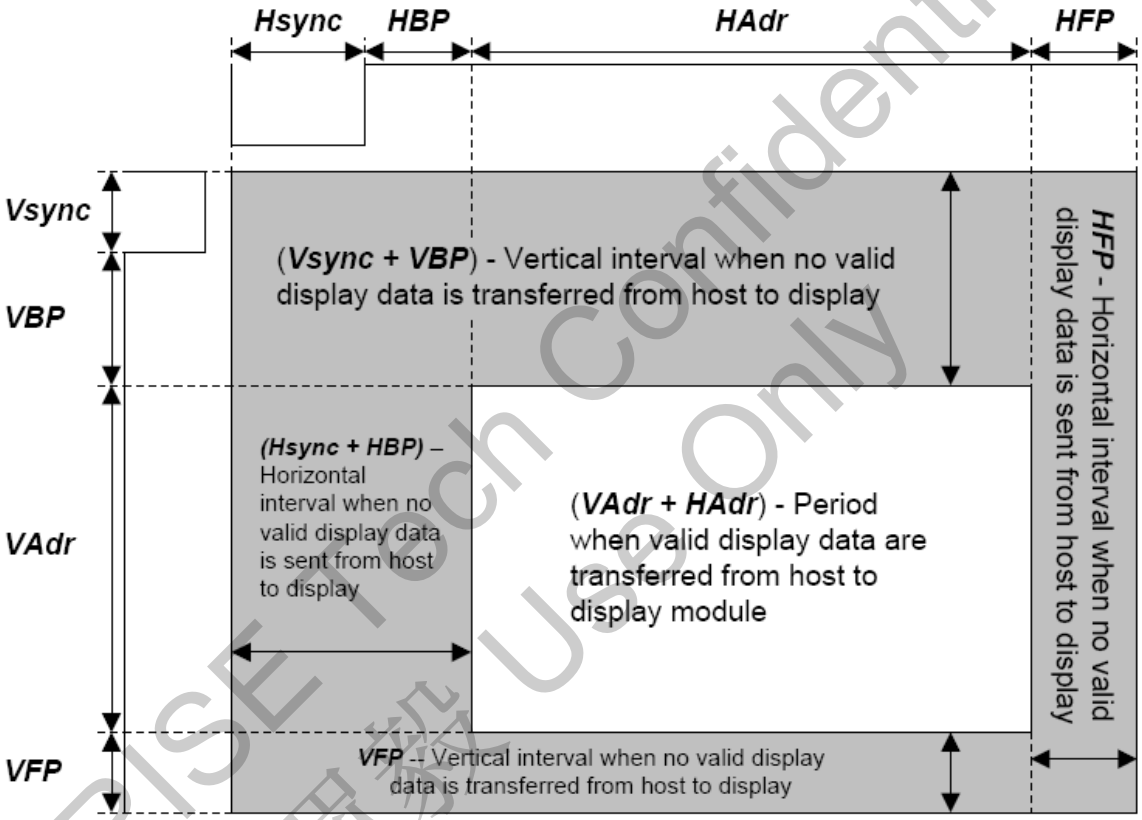

Figure 6.4.2.1 define timing parameter for RGB operation.

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Table 6.4.2.1 provide the timing parameter for support display resolution.

480 horizontal x 800 vertical display timing parameter

Item	Symbol	Condition	Specification			Unit
			Min	Type.	Max	
Vertical Timing						
Vertical cycle period	T_{VP}			832		HS
Vertical low pulse width	T_{VS}		1	10	63	HS
Vertical front porch	T_{VFP}		4	16	63	HS
Vertical back porch	T_{VBP}		3	15	63	HS
Vertical blanking period	T_{VBL}	$T_{VS}+T_{VBP}+T_{VFP}$	8	32	128	HS
Vertical active area	T_{VDISP}			800		HS
Vertical refresh rate	TVRR	Frame rate	-	60.0	-	Hz
Horizontal Timing						
Horizontal cycle period	T_{HP}		520	522	1024	PCLK
Horizontal low pulse width	T_{HS}		2	2	63	PCLK
Horizontal front porch	T_{HFP}		18	20	255	PCLK
Horizontal back porch	T_{HBP}		20	20	255	PCLK
Horizontal blanking period	T_{HBL}	$T_{HS}+T_{HBP}+T_{HFP}$	40	42	1024	PCLK
Horizontal active area	T_{HDISP}			480		PCLK
	$f_{PCLKCYC}$		24	26.37	30.74	MHz

480 horizontal x 854 vertical display timing parameter

Item	Symbol	Condition	Specification			Unit
			Min	Type.	Max	
Vertical Timing						
Vertical cycle period	T_{VP}			886		HS
Vertical low pulse width	T_{VS}		1	10	63	HS
Vertical front porch	T_{VFP}		4	16	63	HS
Vertical back porch	T_{VBP}		3	15	63	HS
Vertical blanking period	T_{VBL}	$T_{VS}+T_{VBP}+T_{VFP}$	8	32	128	HS
Vertical active area	T_{VDISP}			854		HS
Vertical refresh rate	TVRR	Frame rate	-	60.0	-	Hz
Horizontal Timing						
Horizontal cycle period	T_{HP}		520	522	1024	PCLK
Horizontal low pulse width	T_{HS}		2	2	63	PCLK
Horizontal front porch	T_{HFP}		18	20	255	PCLK
Horizontal back porch	T_{HBP}		20	20	255	PCLK
Horizontal blanking period	T_{HBL}	$T_{HS}+T_{HBP}+T_{HFP}$	40	42	1024	PCLK
Horizontal active area	T_{HDISP}			480		PCLK
	$f_{PCLKCYC}$		25.7	28.06	30.74	MHz

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480 horizontal x 864 vertical display timing parameter

Item	Symbol	Condition	Specification			Unit
			Min	Type.	Max	
Vertical Timing						
Vertical cycle period	T_{VP}			896		HS
Vertical low pulse width	T_{VS}		1	10	63	HS
Vertical front porch	T_{VFP}		4	16	63	HS
Vertical back porch	T_{VBP}		3	15	63	HS
Vertical blanking period	T_{VBL}	$T_{VS}+T_{VBP}+T_{VFP}$	8	32	128	HS
Vertical active area	T_{VDISP}			864		HS
Vertical refresh rate	TVRR	Frame rate	-	60.0	-	Hz
Horizontal Timing						
Horizontal cycle period	T_{HP}		520	522	1024	PCLK
Horizontal low pulse width	T_{HS}		2	2	63	PCLK
Horizontal front porch	T_{HFP}		18	20	255	PCLK
Horizontal back porch	T_{HBP}		20	20	255	PCLK
Horizontal blanking period	T_{HBL}	$T_{HS}+T_{HBP}+T_{HFP}$	40	42	1024	PCLK
Horizontal active area	T_{HDISP}			480		PCLK
	$f_{PCLKCYC}$		26	28.38	30.74	MHz

480 horizontal x 720 vertical display timing parameter

Item	Symbol	Condition	Specification			Unit
			Min	Type.	Max	
Vertical Timing						
Vertical cycle period	T_{VP}			752		HS
Vertical low pulse width	T_{VS}		1	10	63	HS
Vertical front porch	T_{VFP}		4	16	63	HS
Vertical back porch	T_{VBP}		3	15	63	HS
Vertical blanking period	T_{VBL}	$T_{VS}+T_{VBP}+T_{VFP}$	8	32	128	HS
Vertical active area	T_{VDISP}			720		HS
Vertical refresh rate	TVRR	Frame rate	-	60.0	-	Hz
Horizontal Timing						
Horizontal cycle period	T_{HP}		520	522	1024	PCLK
Horizontal low pulse width	T_{HS}		2	2	63	PCLK
Horizontal front porch	T_{HFP}		18	20	255	PCLK
Horizontal back porch	T_{HBP}		20	20	255	PCLK
Horizontal blanking period	T_{HBL}	$T_{HS}+T_{HBP}+T_{HFP}$	40	42	1024	PCLK
Horizontal active area	T_{HDISP}			480		PCLK
	$f_{PCLKCYC}$		21.8	23.87	25.8	MHz

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480 horizontal x 480 vertical display timing parameter

Item	Symbol	Condition	Specification			Unit
			Min	Type.	Max	
Vertical Timing						
Vertical cycle period	T_{VP}			512		HS
Vertical low pulse width	T_{VS}		1	10	63	HS
Vertical front porch	T_{VFP}		4	16	63	HS
Vertical back porch	T_{VBP}		3	15	63	HS
Vertical blanking period	T_{VBL}	$T_{VS}+T_{VBP}+T_{VFP}$	8	32	128	HS
Vertical active area	T_{VDISP}			480		HS
Vertical refresh rate	TVRR	Frame rate	-	60.0	-	Hz
Horizontal Timing						
Horizontal cycle period	T_{HP}		520	522	1024	PCLK
Horizontal low pulse width	T_{HS}		2	2	63	PCLK
Horizontal front porch	T_{HFP}		18	20	255	PCLK
Horizontal back porch	T_{HBP}		20	20	255	PCLK
Horizontal blanking period	T_{HBL}	$T_{HS}+T_{HBP}+T_{HFP}$	40	42	1024	PCLK
Horizontal active area	T_{HDISP}			480		PCLK
	$f_{PCLKCYC}$		14.9	16.35	25.8	MHz

480 horizontal x 360 vertical display timing parameter

Item	Symbol	Condition	Specification			Unit
			Min	Type.	Max	
Vertical Timing						
Vertical cycle period	T_{VP}			392		HS
Vertical low pulse width	T_{VS}		1	10	63	HS
Vertical front porch	T_{VFP}		4	16	63	HS
Vertical back porch	T_{VBP}		3	15	63	HS
Vertical blanking period	T_{VBL}	$T_{VS}+T_{VBP}+T_{VFP}$	8	32	128	HS
Vertical active area	T_{VDISP}			360		HS
Vertical refresh rate	TVRR	Frame rate	-	60.0	-	Hz
Horizontal Timing						
Horizontal cycle period	T_{HP}		520	522	1024	PCLK
Horizontal low pulse width	T_{HS}		2	2	63	PCLK
Horizontal front porch	T_{HFP}		18	20	255	PCLK
Horizontal back porch	T_{HBP}		20	20	255	PCLK
Horizontal blanking period	T_{HBL}	$T_{HS}+T_{HBP}+T_{HFP}$	40	42	1024	PCLK
Horizontal active area	T_{HDISP}			480		PCLK
	$f_{PCLKCYC}$		11.5	12.59	25.8	MHz

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6.4.3. RGB interface power on/off sequence

The RGB interface control the normal/shutdown mode by the Sleep-out signal, the on/off sequence as shown in figure as follow.

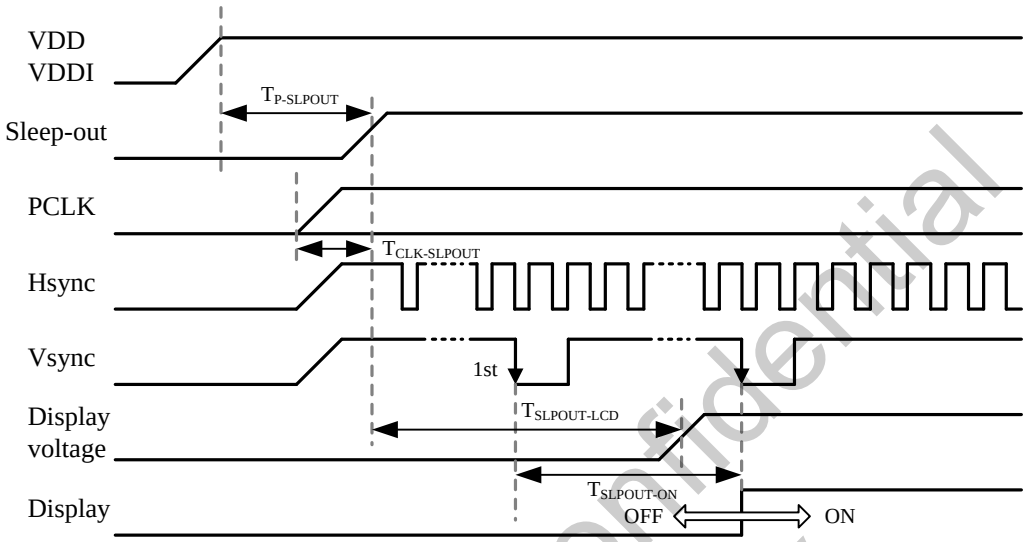

Figure 6.4.3.1 RGB interface Power on and shutdown recovery sequence.

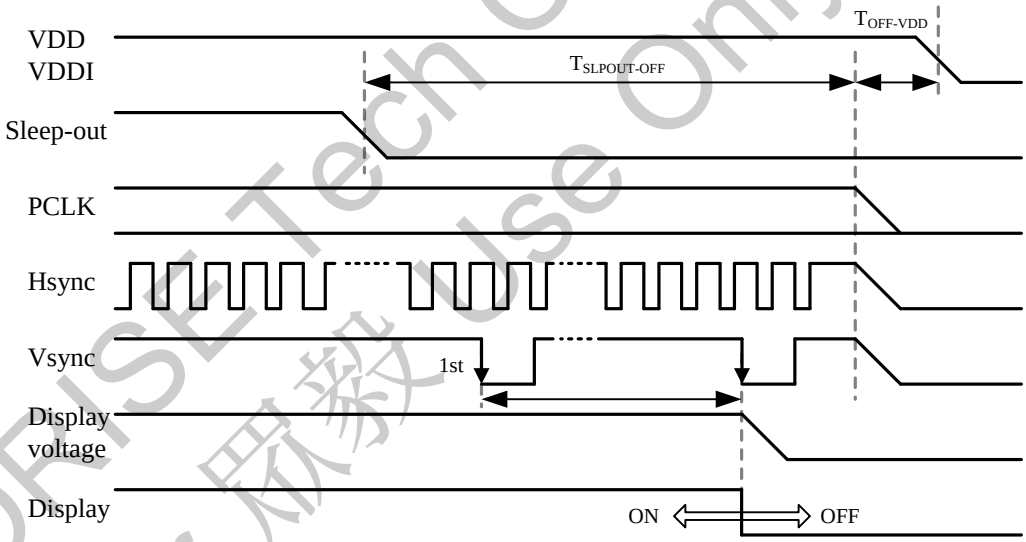

Figure 6.4.3.2 RGB interface Power off and shutdown sequence

Table 6.4.3.3 480 horizontal x 800 vertical display timing parameter

Parameters	Symbols	Min.	Typ	Max.	Unit
V_{DD}/V_{DDI}-on to rising edge of Sleep-out	$T_{P-SLPOUT}$	5	10	-	ms
PCLK input to the rising edge of Sleep-out	$T_{CLK-SLPOUT}$	1	-	-	PCLK
Rising edge of Sleep-out to display voltage ready	$T_{SLPOUT-LCD}$	-	3	-	Frame
Rising edge of Sleep-out to display on	$T_{SLPOUT-ON}$	-	2	-	Frame
Falling edge of Sleep-out to display off	$T_{SLPOUT-OFF}$	-	5	-	Frame
Input-signal-off- to V_{DD}/V_{DDI}-off	$T_{OFF-VDD}$	0	1	-	us

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6.5. MPU-Series Parallel Interface

The MCU uses a 28-wires 24-data parallel interface. The chip-select CSX(active low) enables and disables the parallel interface. RESX (active low) is an external reset signal. WRX is the parallel data write, RDX is the parallel data read and D[23:0] is parallel data.

The Graphics Controller Chip reads the data at the rising edge of WRX signal. The D/CX is the data/command flag. When D/CX='1', D[23:0] bits are display RAM data or command parameters. When D/CX='0', D[23:0] bits are commands.

The 8080-series bi-directional interface can be used for communication between the micro controller and LCD driver chip. The selection of this interface is done when IM[3:0] = 0b0000.

6.5.1. Write cycle sequence

The write cycle means that the host writes information (command or/and data) to the display via the interface. Each write cycle (WRX high-low-high sequence) consists of 3 control (DCX, RDX, WRX) and data signals (DB[23:0]). DCX bit is a control signal, which tells if the data is a command or a data. The data signals are the command if the control signal is low (='0') and vice versa it is data (='1').

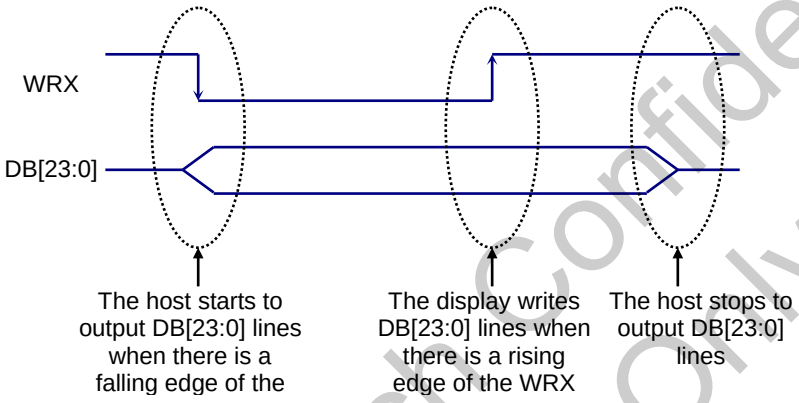

Fig. 6.5.1.1 8080-Series WRX Protocol

Note: WRX is an unsynchronized signal (It can be stopped)

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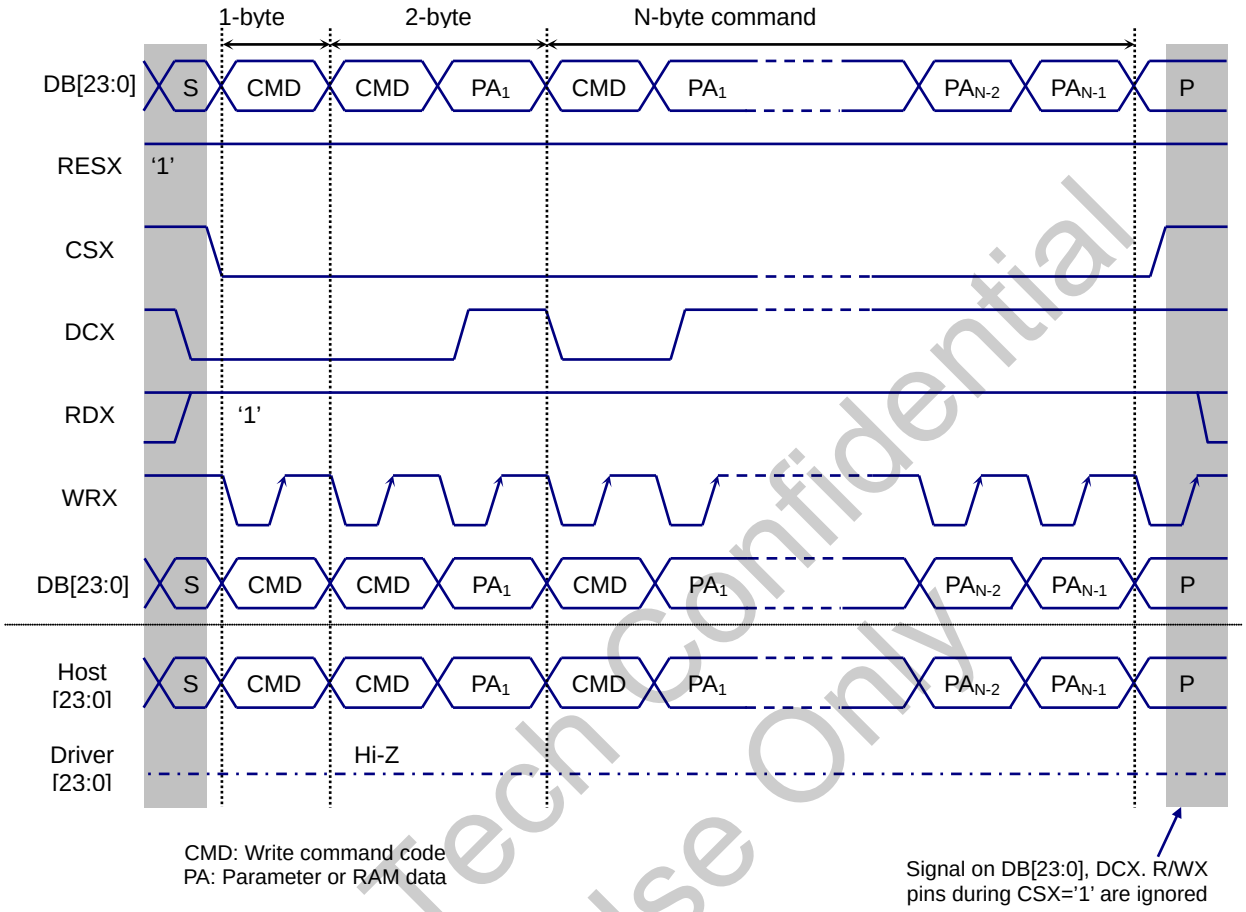

Fig. 6.5.1.2 8080-Series parallel bus protocol, Write to register or display RAM

6.5.2. Read cycle sequence

The read cycle (RDX high-low-high sequence) means that the host reads information from display via interface. The display sends data (DB[23:0]) to the host when there is a falling edge of RDX and the host reads data when there is a rising edge of RDX.

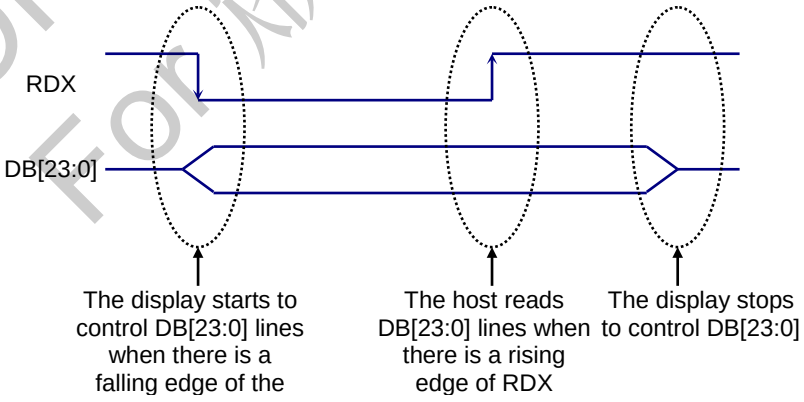

Fig. 6.5.2.1 8080-Series RDX Protocol

Note: RDX is an unsynchronized signal (It can be stopped)

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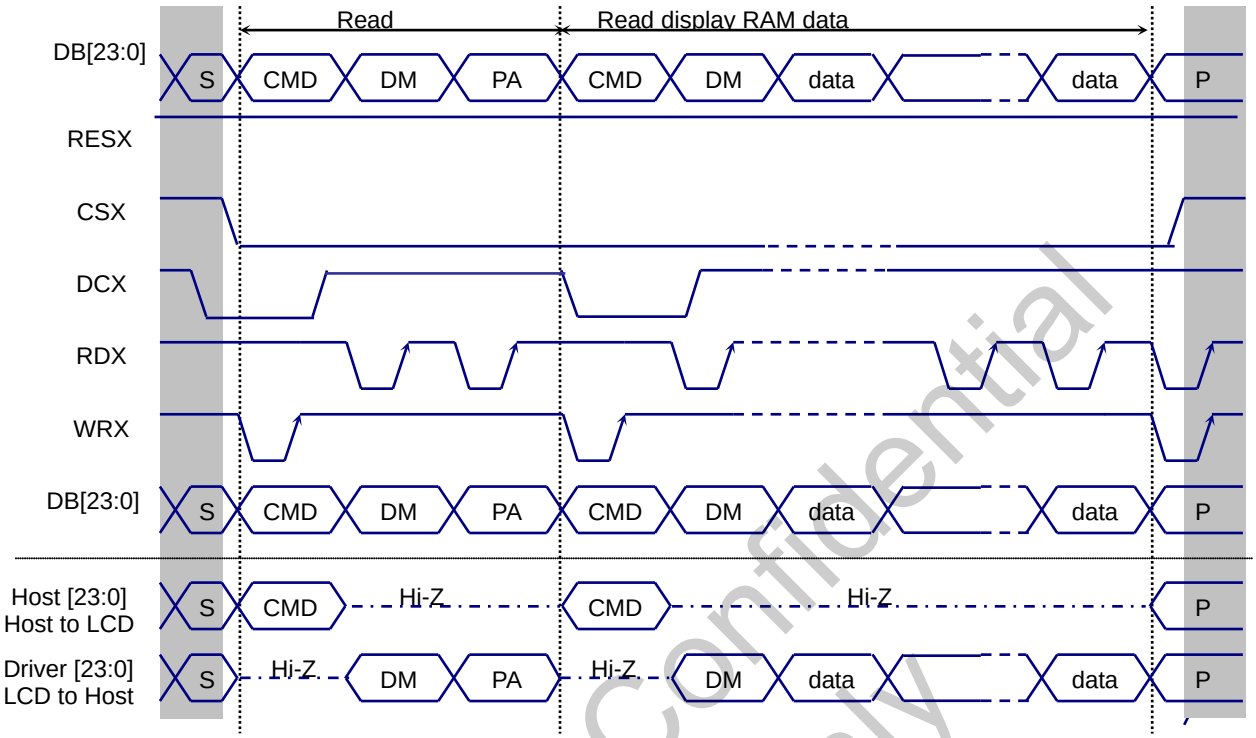

CMD: Write command code
PA: Parameter or RAM data
DM: Dummy

Signal on DB[23:0], DCX. R/WX, E pins during CSX='1' are ignored

Fig. 6.5.2.2 8080-Series parallel bus protocol, Read data from register or display RAM

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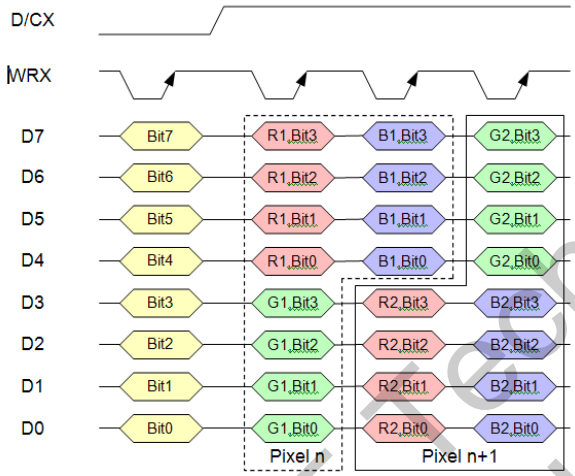
6.5.3. MPU mode color coding

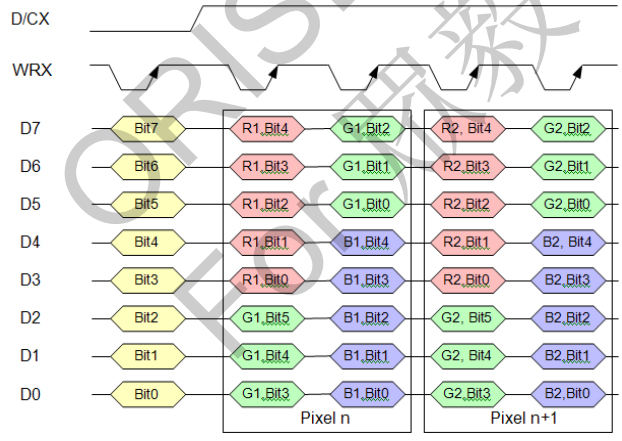
Color coding uses a red [R], green [G] and blue [B] additive color mixing method. R, G and B are used for each color data index in the following sections.

6.5.3.1. 8-bit Interface color coding

BUS	COLOR	D7	D6	D5	D4	D3	D2	D1	D0
8	444	R1[3]	R1[2]	R1[1]	R1[0]	G1[3]	G1[2]	G1[1]	G1[0]
		B1[3]	B1[2]	B1[1]	B1[0]	R2[3]	R2[2]	R2[1]	R2[0]
		G2[3]	G2[2]	G2[1]	G2[0]	B2[3]	B2[2]	B2[1]	B2[0]
	565	R1[4]	R1[3]	R1[2]	R1[1]	R1[0]	G1[5]	G1[4]	G1[3]
		G1[2]	G1[1]	G1[0]	B1[4]	B1[3]	B1[2]	B1[1]	B1[0]
	666	R1[5]	R1[4]	R1[3]	R1[2]	R1[1]	R1[0]	X	X
		G1[5]	G1[4]	G1[3]	G1[2]	G1[1]	G1[0]	X	X
		B1[5]	B1[4]	B1[3]	B1[2]	B1[1]	B1[0]	X	X
	888	R1[7]	R1[6]	R1[5]	R1[4]	R1[3]	R1[2]	R1[1]	R1[0]
		G1[7]	G1[6]	G1[5]	G1[4]	G1[3]	G1[2]	G1[1]	G1[0]
		B1[7]	B1[6]	B1[5]	B1[4]	B1[3]	B1[2]	B1[1]	B1[0]



12-bits/pixel (R 4-bit, G 4-bit, B 4-bit), 4,096 Colors



16-bits/pixel (R 5-bit, G 6-bit, B 5-bit), 65,536 Colors

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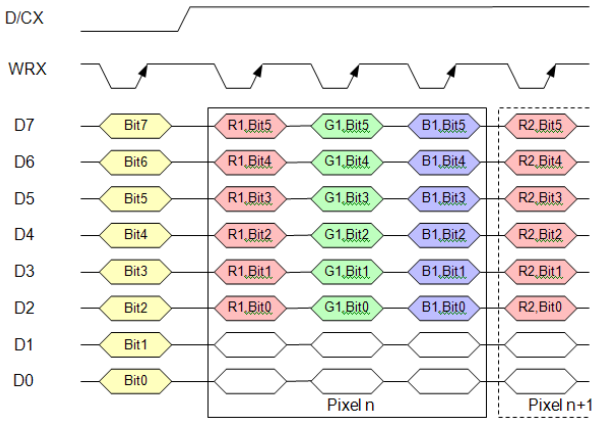
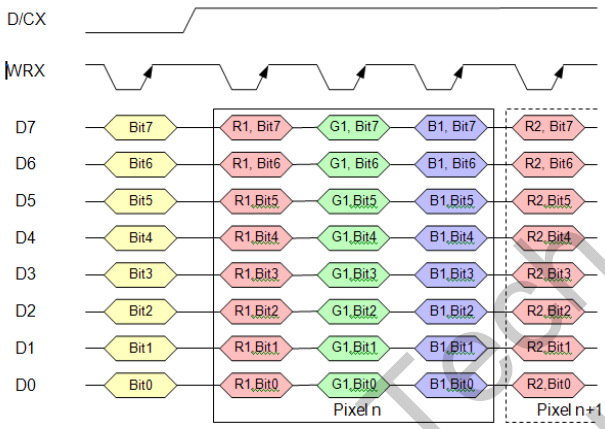


18-bits/pixel (R 6-bit, G 6-bit, B 6-bit), 262,144 Colors



24-bits/pixel (R 8-bit, G 8-bit, B 8-bit), 16,777,216 Colors

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6.5.3.2. 16-bit Interface color coding

444	X	X	X	X	R1[3]	R1[2]	R1[1]	R1[0]	G1[3]	G1[2]	G1[1]	G1[0]	B1[3]	B1[2]	B1[1]	B1[0]
565	R1[4]	R1[3]	R1[2]	R1[1]	R1[0]	G1[5]	G1[4]	G1[3]	G1[2]	G1[1]	G1[0]	B1[4]	B1[3]	B1[2]	B1[1]	B1[0]
666 OPT1	R1[5]	R1[4]	R1[3]	R1[2]	R1[1]	R1[0]	X	X	G1[5]	G1[4]	G1[3]	G1[2]	G1[1]	G1[0]	X	X
	B1[5]	B1[4]	B1[3]	B1[2]	B1[1]	B1[0]	X	X	R2[5]	R2[4]	R2[3]	R2[2]	R2[1]	R2[0]	X	X
	G2[5]	G2[4]	G2[3]	G2[2]	G2[1]	G2[0]	X	X	B2[5]	B2[4]	B2[3]	B2[2]	B2[1]	B2[0]	X	X
666 OPT2	X	X	X	X	X	X	X	X	R1[5]	R1[4]	R1[3]	R1[2]	R1[1]	R1[0]	X	X
	G1[5]	G1[4]	G1[3]	G1[2]	G1[1]	G1[0]	X	X	B1[5]	B1[4]	B1[3]	B1[2]	B1[1]	B1[0]	X	X
888 OPT1	R1[7]	R1[6]	R1[5]	R1[4]	R1[3]	R1[2]	R1[1]	R1[0]	G1[7]	G1[6]	G1[5]	G1[4]	G1[3]	G1[2]	G1[1]	G1[0]
	B1[7]	B1[6]	B1[5]	B1[4]	B1[3]	B1[2]	B1[1]	B1[0]	R2[7]	R2[6]	R2[5]	R2[4]	R2[3]	R2[2]	R2[1]	R2[0]
	G2[7]	G2[6]	G2[5]	G2[4]	G2[3]	G2[2]	G2[1]	G2[0]	B2[7]	B2[6]	B2[5]	B2[4]	B2[3]	B2[2]	B2[1]	B2[0]
888 OPT2	X	X	X	X	X	X	X	X	R1[7]	R1[6]	R1[5]	R1[4]	R1[3]	R1[2]	R1[1]	R1[0]
	G1[7]	G1[6]	G1[5]	G1[4]	G1[3]	G1[2]	G1[1]	G1[0]	B1[7]	B1[6]	B1[5]	B1[4]	B1[3]	B1[2]	B1[1]	B1[0]

12-bits/pixel (R 4-bit, G 4-bit, B 4-bit), 4,096 Colors

16-bits/pixel (R 5-bit, G 6-bit, B 5-bit), 65,536 Colors

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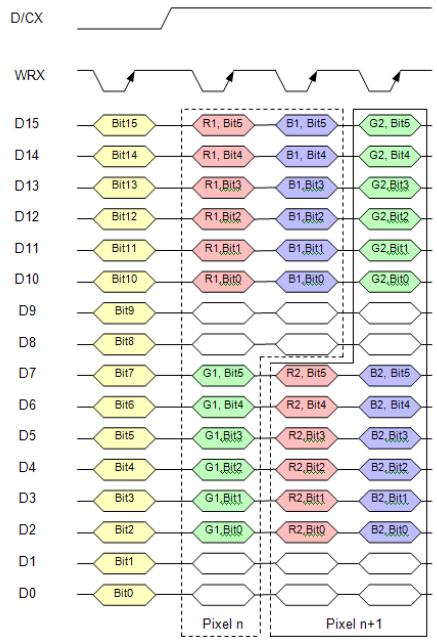
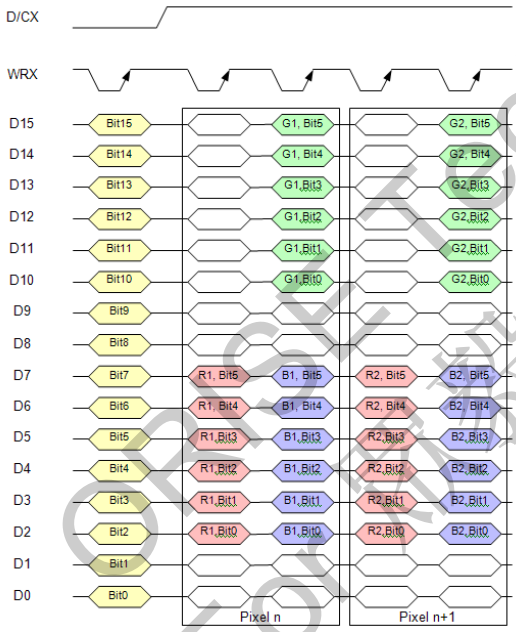


18-bits/pixel (R 6-bit, G 6-bit, B 6-bit), 262,144 Colors (DBIFMT = 0)



18-bits/pixel (R 6-bit, G 6-bit, B 6-bit), 262,144 Colors (DBIFMT = 1)

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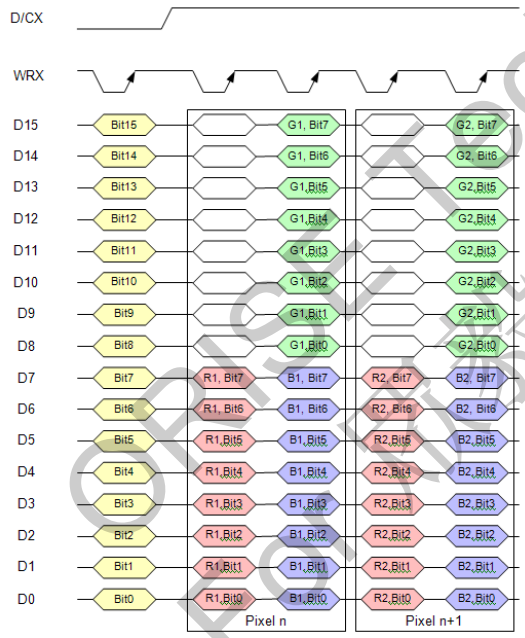
24-bits/pixel (R 8-bit, G 8-bit, B 8-bit), 16,777,216 Colors (DBIFMT = 0)



24-bits/pixel (R 8-bit, G 8-bit, B 8-bit), 16,777,216 Colors (DBIFMT = 1)

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6.5.3.3. 24-bit Interface color coding

BUS	COLOR	D23	D22	D21	D20	D19	D18	D17	D16	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
24	444	X	X	X	X	X	X	X	X	X	X	X	X	R1[3]	R1[2]	R1[1]	R1[0]	G1[3]	G1[2]	G1[1]	G1[0]	B1[3]	B1[2]	B1[1]	B1[0]
	565	X	X	X	X	X	X	X	X	R1[4]	R1[3]	R1[2]	R1[1]	R1[0]	G1[5]	G1[4]	G1[3]	G1[2]	G1[1]	G1[0]	B1[4]	B1[3]	B1[2]	B1[1]	B1[0]
	666	X	X	X	X	X	X	R1[5]	R1[4]	R1[3]	R1[2]	R1[1]	R1[0]	G1[5]	G1[4]	G1[3]	G1[2]	G1[1]	G1[0]	B1[5]	B1[4]	B1[3]	B1[2]	B1[1]	B1[0]
	888	R1[7]	R1[6]	R1[5]	R1[4]	R1[3]	R1[2]	R1[1]	R1[0]	G1[7]	G1[6]	G1[5]	G1[4]	G1[3]	G1[2]	G1[1]	G1[0]	B1[7]	B1[6]	B1[5]	B1[4]	B1[3]	B1[2]	B1[1]	B1[0]

6.6. I²C-Bus Interface

6.6.1. Characteristics of I²C-bus

The I²C-bus is for bi-directional, two-line communication between different ICs or modules. The two lines compose of a serial data line (SDA) and a serial clock line (SCL). Both lines must be connected to a positive supply via a pull-up resistor. Data transfer may be initiated only when the bus is not busy.

6.6.1.1. System configuration (see figure 6.6.1.1)

(1) Transmitter: the device which sends the data to the bus

(2) Receiver: the device which receives the data from the bus

(3) Master: the device which initiates a transfer, generates clock signals and terminates a transfer

(4) Slave: the device addressed by a master

(5) Multi-Master: more than one master attempts to control the bus at the same time without corrupting the message

(6) Arbitration: procedure to ensure that, if more than one master simultaneously tries to control the bus, only one is allowed to do so and the message is not corrupted.

(7) Synchronization: procedure to synchronize the clock signals of two or more devices.

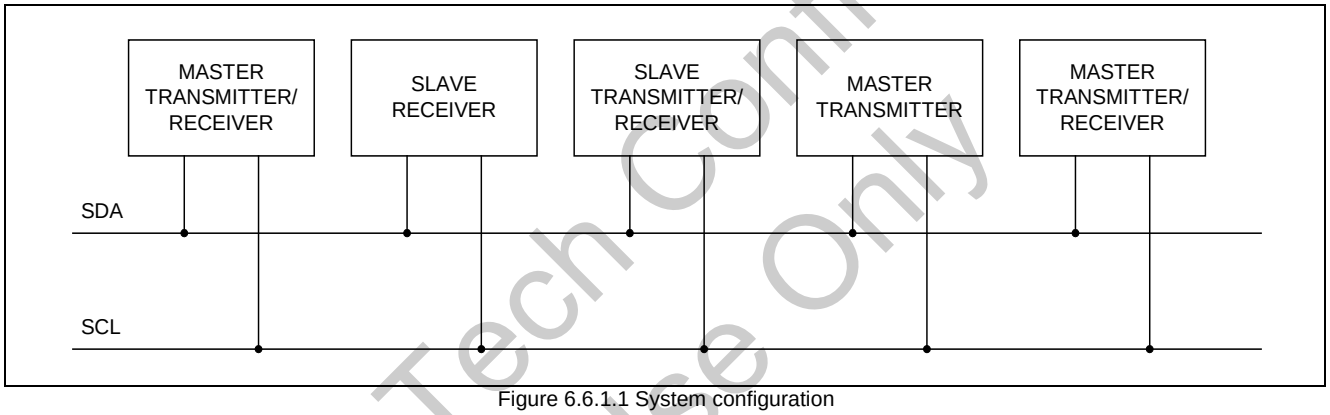

Figure 6.6.1.1 System configuration

6.6.1.2. Bit transfer (See Figure 6.6.1.2)

One data bit is transferred during each clock pulse. The data on SDA line must remain stabilized during the HIGH period of the clock pulse. As changes in the data line at this time will be interpreted as a control signal.

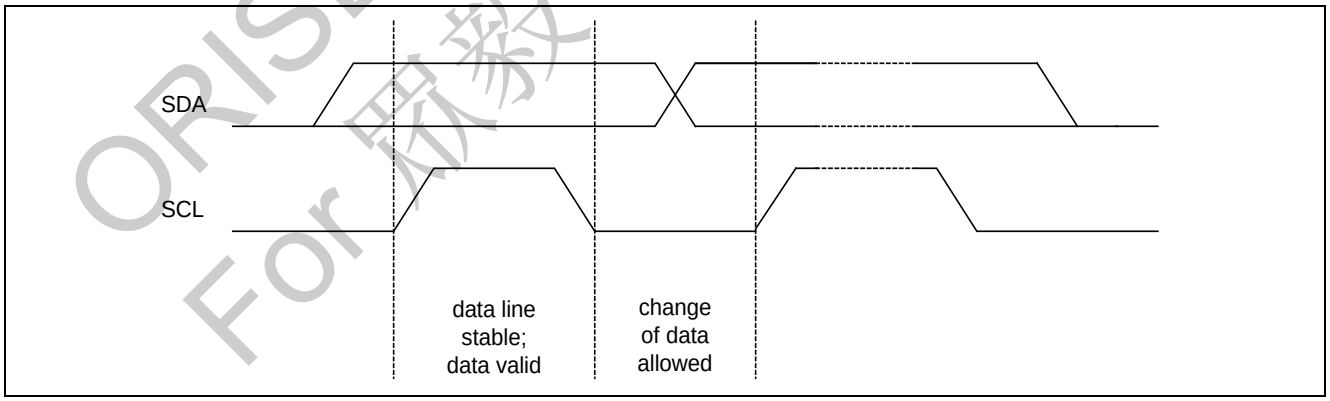

Figure 6.6.1.2 Bit transfer.

6.6.1.3. START and STOP conditions (See Figure 6.6.1.3)

Both data and clock lines remain HIGH when the bus is not busy. A HIGH-to-LOW transition on the data line, while the clock is HIGH, is defined as the START condition (S). A LOW-to-HIGH transition on the data line is defined as the STOP condition (P) while the clock is HIGH.

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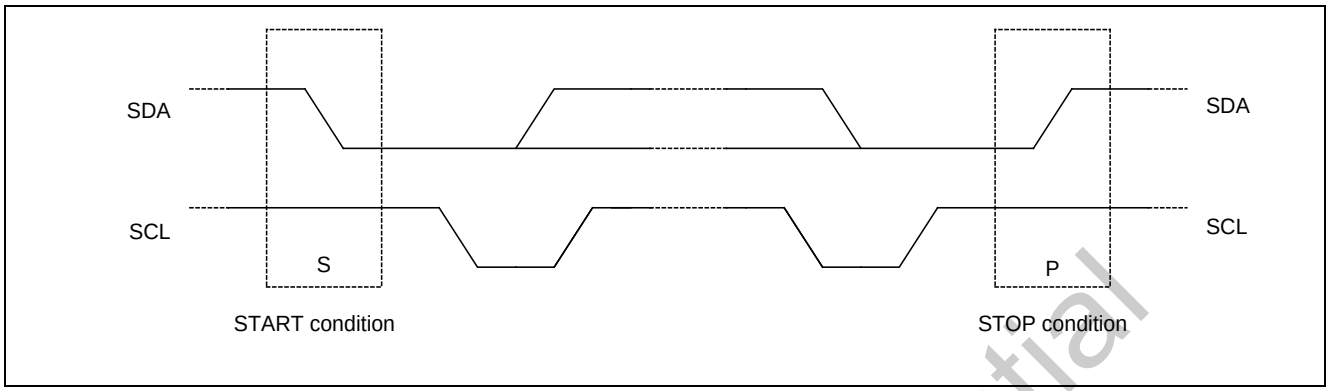

Figure 6.6.1.3 Definition of START and STOP conditions.

6.6.1.4. Acknowledgment (See Figure 6.6.1.4)

Each bit in a byte (8 bits) is followed by an acknowledgment bit. The acknowledgment bit is a HIGH signal placed on the bus by the transmitter during the master generating an extra acknowledgment related clock pulse.

An addressed slave receiver must generate an acknowledgment after the reception of each byte. Also a master receiver must generate an acknowledgment after the reception of each byte that has been clocked out of the slave transmitter.

The acknowledged device must pull-down the SDA line during the acknowledgment clock pulse, so that the SDA line remains LOW during the HIGH period of the acknowledgment related clock pulse (setup and hold times must be considered).

A master receiver must signal an end of data to the transmitter by not generating an acknowledgment on the last byte that has been clocked out of the slave. In this event, the transmitter must leave the data line HIGH to enable the master to generate a stop condition.

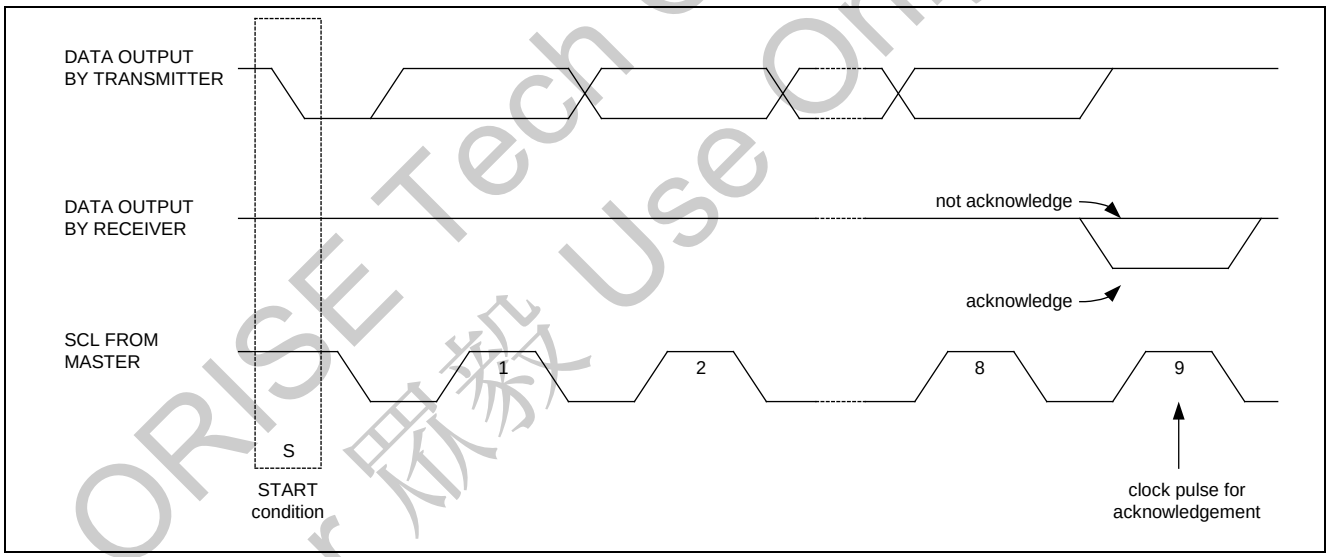

Figure 6.6.1.4 Acknowledgement on the I²C-bus.

6.6.2. I²C-bus protocol

Before any data is transmitted on the I²C-bus, the device to respond is addressed first. Two 7-bit slave addresses (10011xx) are reserved for the OTM8009A. The least significant bit of the slave address is set by connecting the input I2C_SA[1:0].

I2C_SA1	I2C_SA0	Slave address	Notes
0	0	1001100	Other slave address are reversed for other IC.
0	1	1001101	
1	0	1001110	
1	1	1001111	

Table 6.6.2.1 Reserve address for OTM8009A.

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6.6.2.1. I²C-bus Write Instruction and parameter

OTM8009A supports register write sequence via I2C-bus transfer. The detail transference sequences are illustrated and described as below.

(1) Data transfers for register writing follow the format is shown in Figure 6.6.2.1.

(2) After the START condition (Str), a slave address is sent. R/W bit is setting to "zero" for WRITE.

(3) The slave issues an ACK to master.

(4) 16 bits register high byte address transfer first. Then transfer the register low byte address.

(5) 16 bits register high byte data of parameter transfer first. Then transfer the register low byte data parameter .

(6) A data transfer is always terminated by a STOP condition.

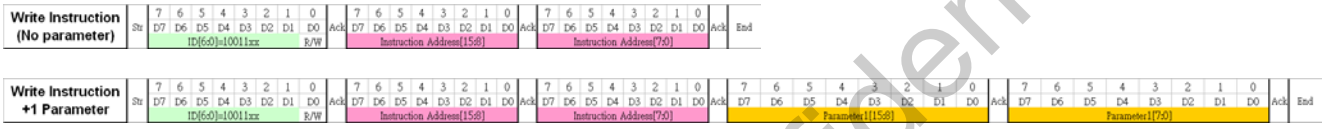

Figure 6.6.2.1 I²C write stream for write command

6.6.2.2. I²C-bus Write GRAM

Figure 6.6.2.2 Color format and I²C write stream

Note :

(1) 4096 color : 3 bytes = 2 pixels

(2) 65536 color: 2 bytes = 1 pixel

(3) 262K color: 3bytes = 1 pixel

(4) 16.7M color: 3bytes = 1 pixel

(5) 8 color(idle mode): 1 byte = 2 pixel

6.6.2.3. I²C-bus read

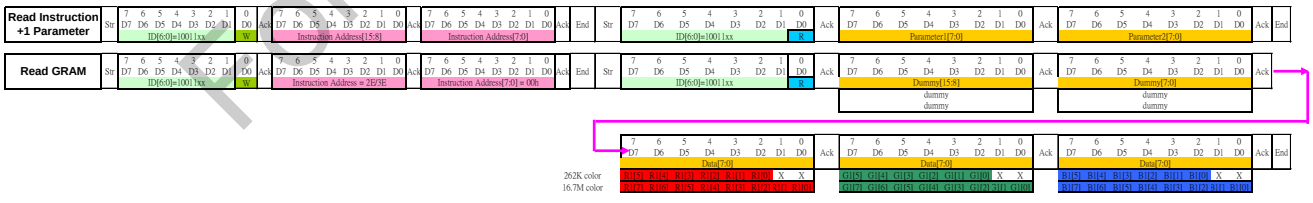

Figure 6.6.2.3 Color format and I²C read stream

Note : OTM8009A only support 16.7M / 262K color for GRAM read back.

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6.7. Serial interface (SPI)

The selection of this interface is done by set IM2 / IM1 / IM0 = 011. And select IM3 = 0 or 1 to decide the trigger edge of serial clock (SCL) is rising edge or falling edge. The serial interface is used to communication between the micro controller and the LCD driver chip. It contains CSX (chip select), SCL (serial clock), SDI (serial data input) and SDO (serial data output). Serial clock (SCL) is used for interface with MPU only, so it can be stopped when no communication is necessary. If the host places the SDI line into high-impedance state during the read intervals, then the SDI and SDO can be tied together.

6.7.1. SPI Write Mode

The write mode of the interface means the micro controller writes commands and data to the OTM8009A. The serial interface is initialized when CSX is high. In this state, SCL clock pulse or SDI data have no effect. A falling edge on CSX enables the serial interface and indicates the start of data transmission.

When CSX is high, SCL clock is ignored. During the high time of CSX the serial interface is initialized. At the falling CSX edge, SCL can be high or low (See Figure 6.7.1.1). SDI / SDO is sampled at the rising edge of SCL. R/W indicates, whether the byte is read command (R/W = '1') or write command (R/W = '0'). It is sampled when first rising SCL edge. If CSX stays low after the last bit of command/data byte, the serial interface expects the R/W bit of the next byte at the next rising edge of SCL.

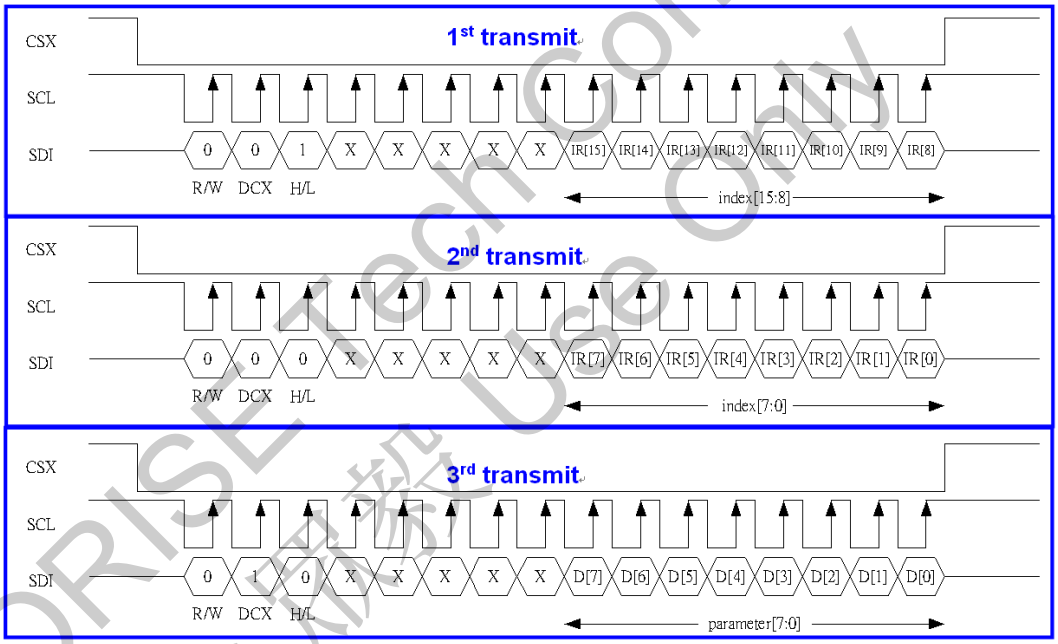

Figure 6.7.1.1 SPI Protocol for register write mode

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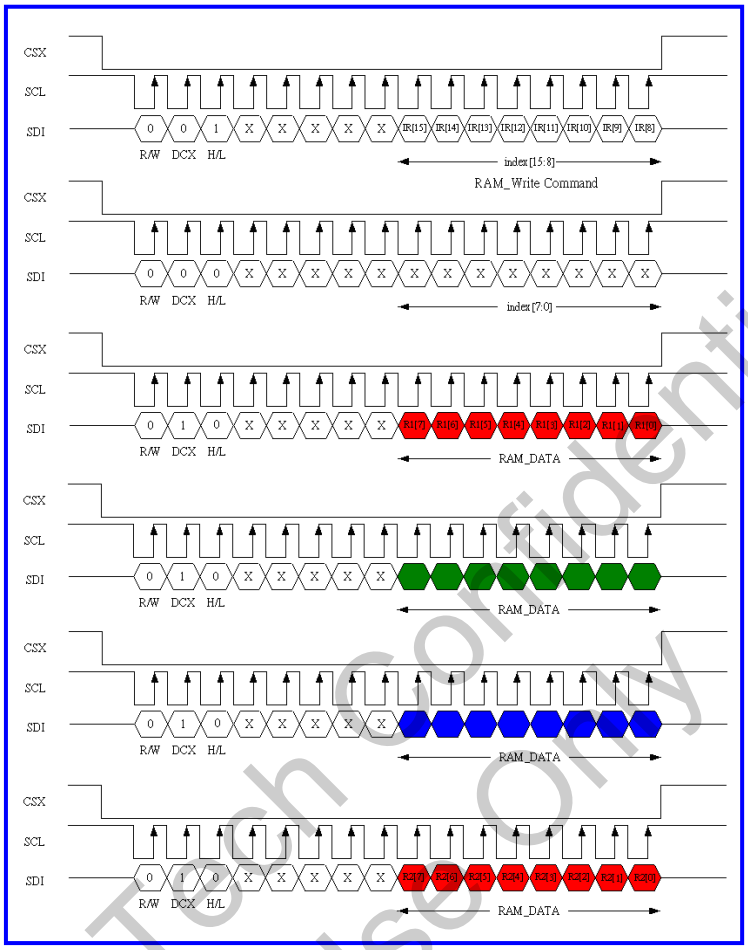

Figure 6.7.1.2 SPI Protocol for GRAM write (Separate byte mode)

	SPI interface		7	6	5	4	3	2	1	0	
			D7	D6	D5	D4	D3	D2	D1	D0	
RAM Write	444	3T2P	R1[3]	R1[2]	R1[1]	R1[0]	G1[3]	G1[2]	G1[1]	G1[0]	1'st transmit
			B1[3]	B1[2]	B1[1]	B1[0]	R2[3]	R2[2]	R2[1]	R2[0]	2'nd transmit
			G2[3]	G2[2]	G2[1]	G2[0]	B2[3]	B2[2]	B2[1]	B2[0]	3'rd transmit
	565	2T1P	R1[4]	R1[3]	R1[2]	R1[1]	R1[0]	G1[5]	G1[4]	G1[3]	1'st transmit
			G1[2]	G1[1]	G1[0]	B1[4]	B1[3]	B1[2]	B1[1]	B1[0]	2'nd transmit
	666	3T1P	R1[5]	R1[4]	R1[3]	R1[2]	R1[1]	R1[0]	X	X	1'st transmit
			G1[5]	G1[4]	G1[3]	G1[2]	G1[1]	G1[0]	X	X	2'nd transmit
			B1[5]	B1[4]	B1[3]	B1[2]	B1[1]	B1[0]	X	X	3'rd transmit
	888	3T1P	R1[7]	R1[6]	R1[5]	R1[4]	R1[3]	R1[2]	R1[1]	R1[0]	1'st transmit
			G1[7]	G1[6]	G1[5]	G1[4]	G1[3]	G1[2]	G1[1]	G1[0]	2'nd transmit
			B1[7]	B1[6]	B1[5]	B1[4]	B1[3]	B1[2]	B1[1]	B1[0]	3'rd transmit
	8 color OPT-1	1T2P	X	X	R1[0]	G1[0]	B1[0]	R2[0]	G2[0]	B2[0]	1'st transmit
	8 color OPT-2	1T2P	X	R1[0]	G1[0]	B1[0]	X	R2[0]	G2[0]	B2[0]	1'st transmit

Table 6.7.1.3 Available color format for SPI interface

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6.7.2. SPI Read Mode

The read mode of the interface means that the micro controller reads register value from the OTM8009A. To do so the micro controller first has to send a command and then the following byte is transmitted in the opposite direction. After that CSX is required to go high before a new command is send (see Figure. 6.7.2.1). The OTM8009A samples the SDI (input data) at the rising edges, but shifts SDO (output data) at the falling SCL edges. Thus the micro controller is supported to read data at the rising SCL edges. After the read status command has been sent, the SDI line must be set to tri-state no later than at the falling SCL edge of the last bit. For the memory data read, a dummy clock cycle is needed (16 SCL clocks) to wait the memory data send out in SPI interface. But it doesn't need any dummy clock when execute the command data read.

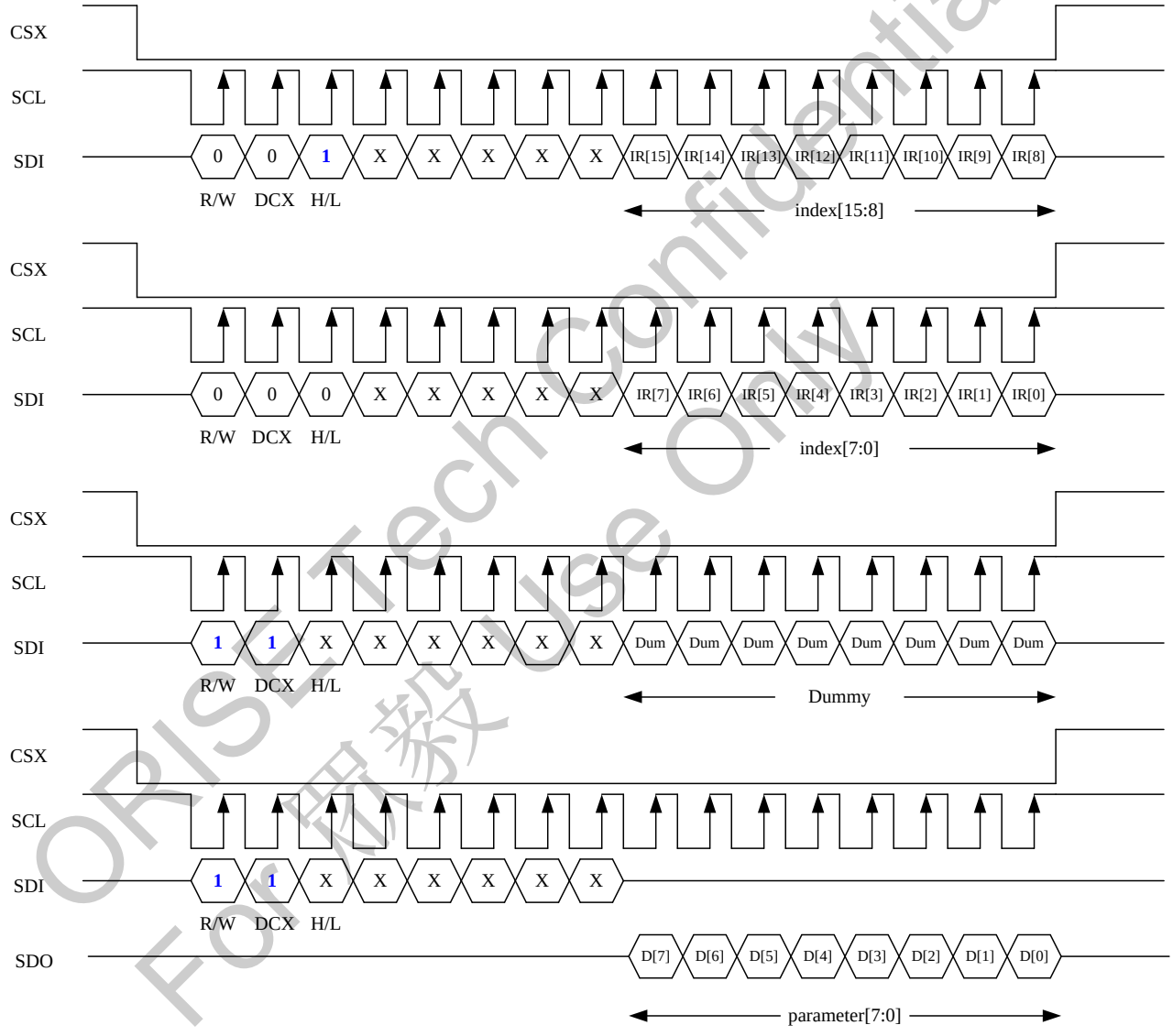

Figure 6.7.2.1 SPI Protocol for register read mode

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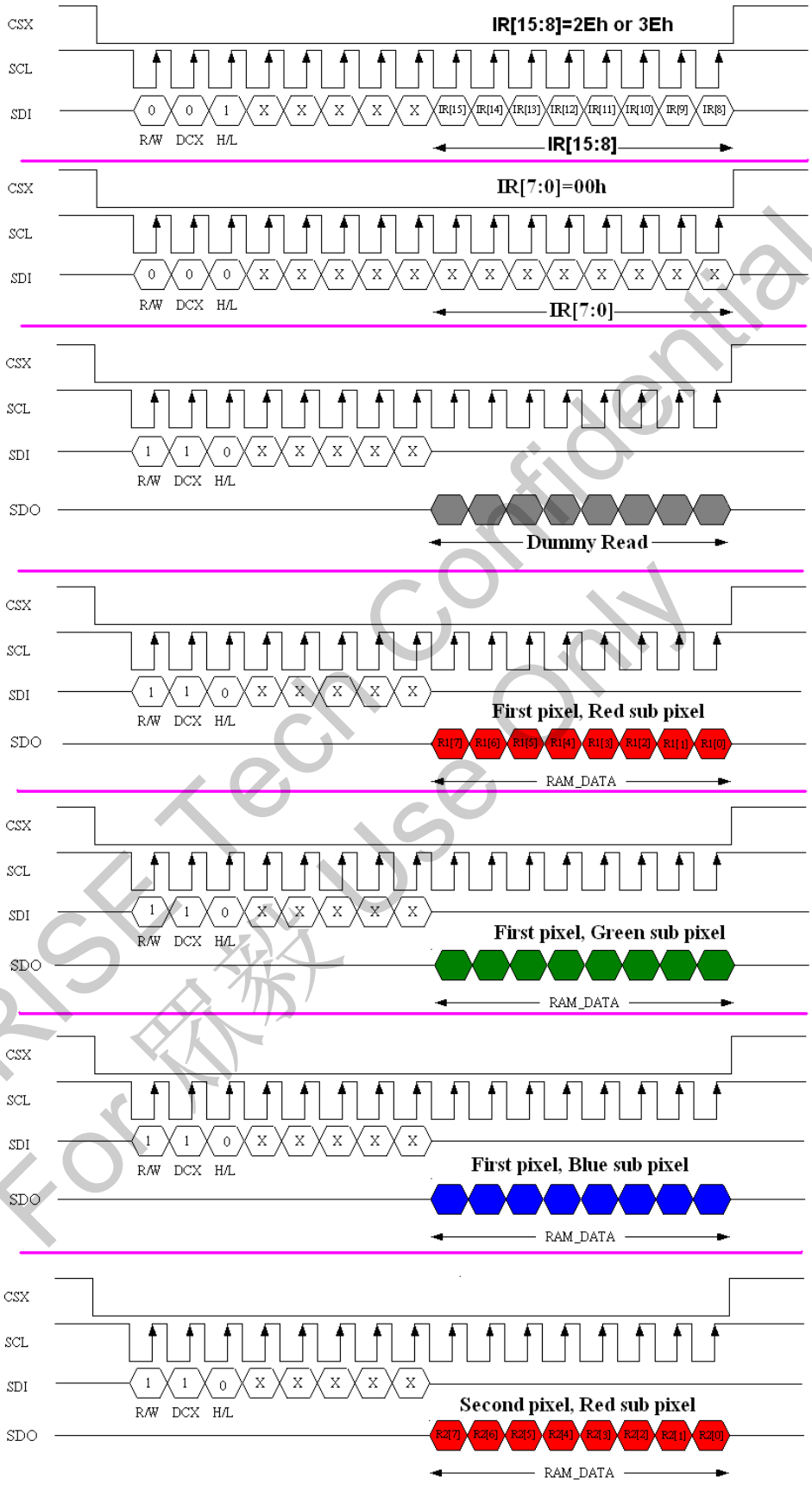

Figure 6.7.2.2 SPI Protocol for GRAM read

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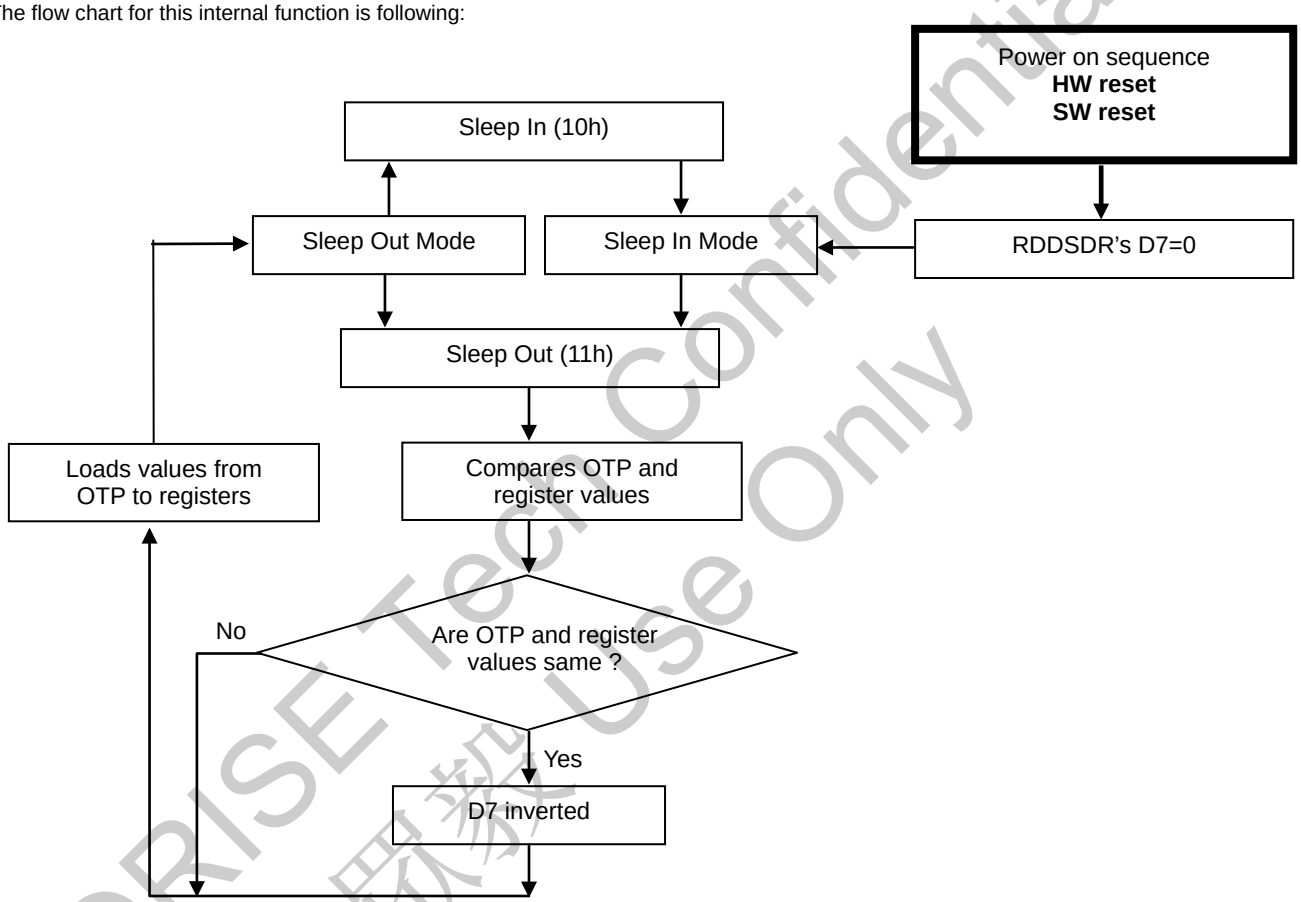
6.8. Sleep Out-Command And Self-Diagnostic Functions Of The Display Module

6.8.1. Register loading detection

Sleep Out-command is a trigger for an internal function of the display module, which indicates, if the display module loading function of factory default values from OTP (one-time programming memory) to registers of the display controller is working properly.

There are compared factory values of the OTP and register values of the display controller by the display controller. If those both values (OTP and register values) are same, there is inverted (=increased by 1) a bit in “Read Display Self-Diagnostic Result (0Fh)” (=RDDSDR) (The used bit of this command is D7). If those both values are not same, this bit (D7) is not inverted (= increased by 1).

The flow chart for this internal function is following:



Note: There is not compared and loaded register values, which can be changed by user (00h to AFh and DAh to DDh), by the display module.

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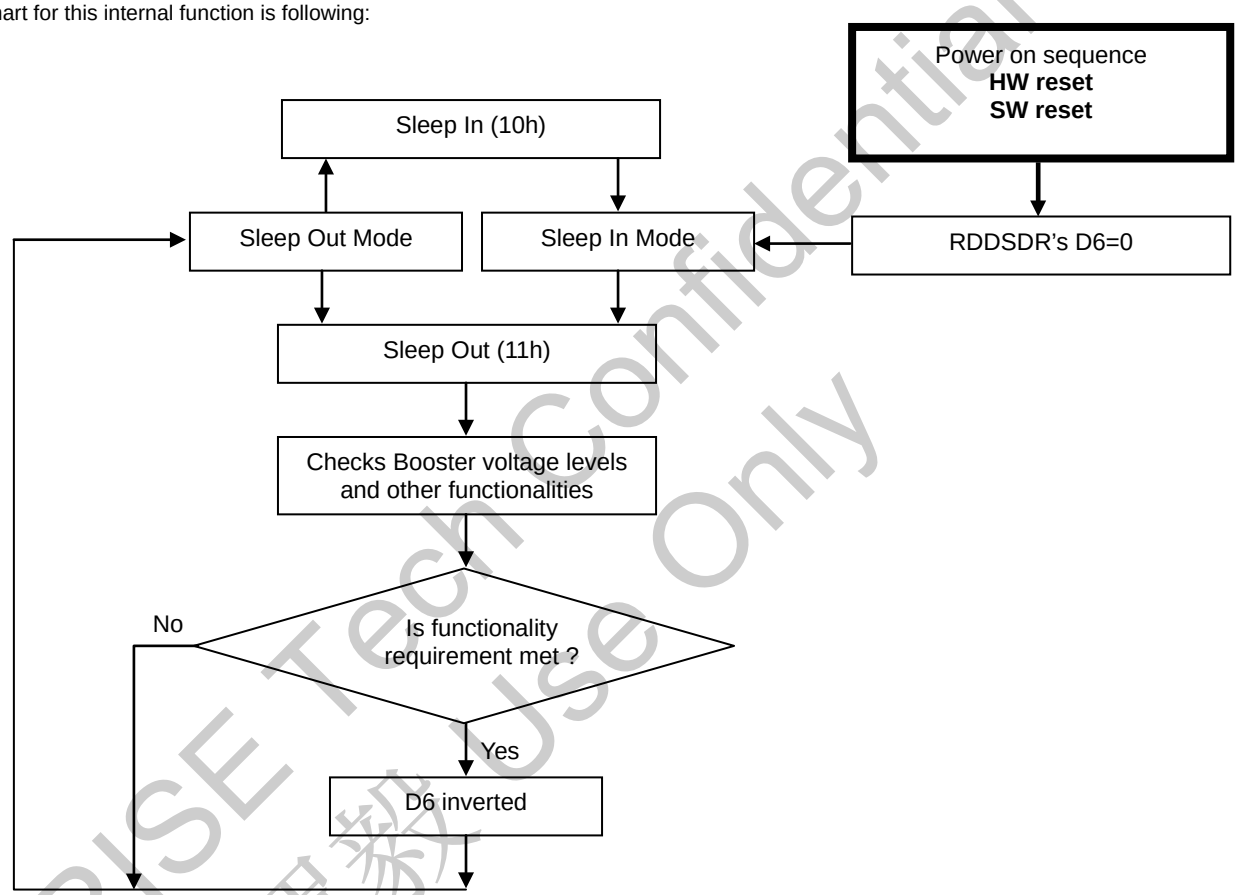
6.8.2. Functionality detection

Sleep Out-command is a trigger for an internal function of the display module, which indicates, if the display module is still running and meets functionality requirements.

The internal function (= the display controller) is comparing, if the display module is still meeting functionality requirements (only Booster voltage level). If functionality requirement is met, there is inverted (= increased by 1) a bit in “Read Display Self- Diagnostic Result (0Fh)” (= RDDSDR) (The used bit of this command is D6). If functionality requirement is not same, this bit (D6) is not inverted (= increased by 1).

The flow chart for this internal function is following:



Note: There is needed 120msec after Sleep Out -command, when there is changing from Sleep In –mode to Sleep Out -mode, before there is possible to check if functionality requirements are met and a value of RDDSDR’s D6 is valid. Otherwise, there is 5msec delay for D6’s value, when Sleep Out –command is sent in Sleep Out -mode.

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6.9. Power On/Off Sequence

VDDIO and VDD can be applied in any order.

VDDIO and VDD can be powered down in any order.

During power off, if LCD is in the Sleep Out mode, VDD and VDDIO must be powered down minimum 120msec after RESX has been released.

During power off, if LCD is in the Sleep In mode, VDDIO or VDD can be powered down minimum 0msec after RESX has been released.

CSX can be applied at any timing or can be permanently grounded. RESX has priority over CSX.

Note 1: There will be no damage to the display module if the power sequences are not met.

Note 2: There will be no abnormal visible effects on the display panel during the Power On/Off Sequences.

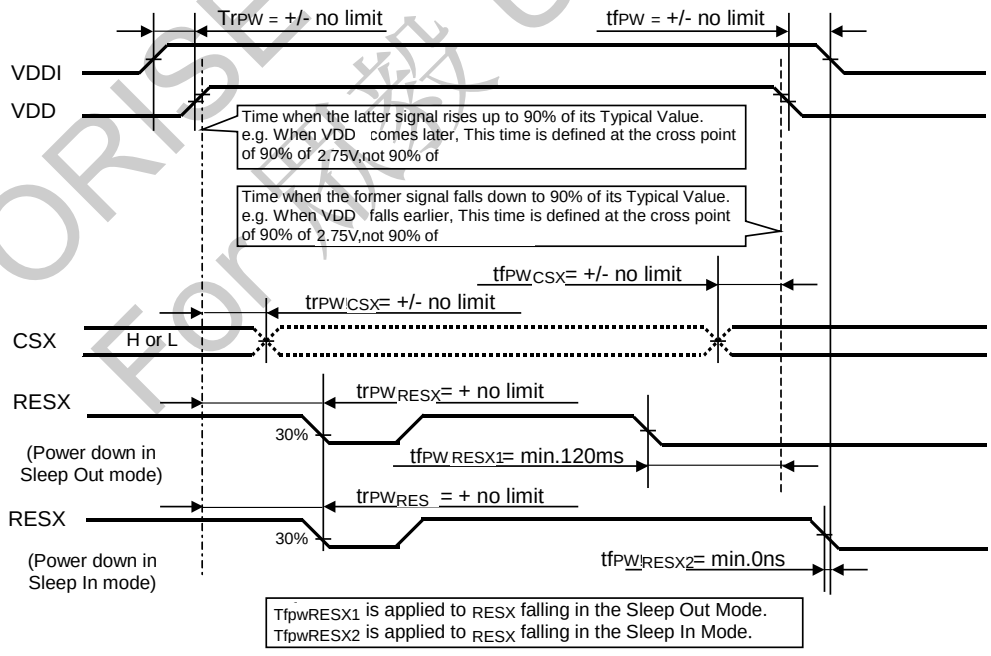
Note 3: There will be no abnormal visible effects on the display between end of Power On Sequence and before receiving Sleep Out command. Also between receiving Sleep In command and Power Off Sequence.

If RESX line is not held stable by host during Power On Sequence, then it will be necessary to apply a Hardware Reset (RESX) after Host Power On Sequence is complete to ensure correct operation. Otherwise function is not guaranteed.

The power on/off sequence is illustrated below:

6.9.1. Case 1 – RESX line is held high or unstable by host at power on

If RESX line is held High or unstable by the host during Power On, then a Hardware Reset must be applied after both VDD and VDDIO have been applied – otherwise correct functionality is not guaranteed. There is no timing restriction upon this hardware reset.



Note: Unless otherwise specified, timings herein show cross point at 50% of signal/power level.

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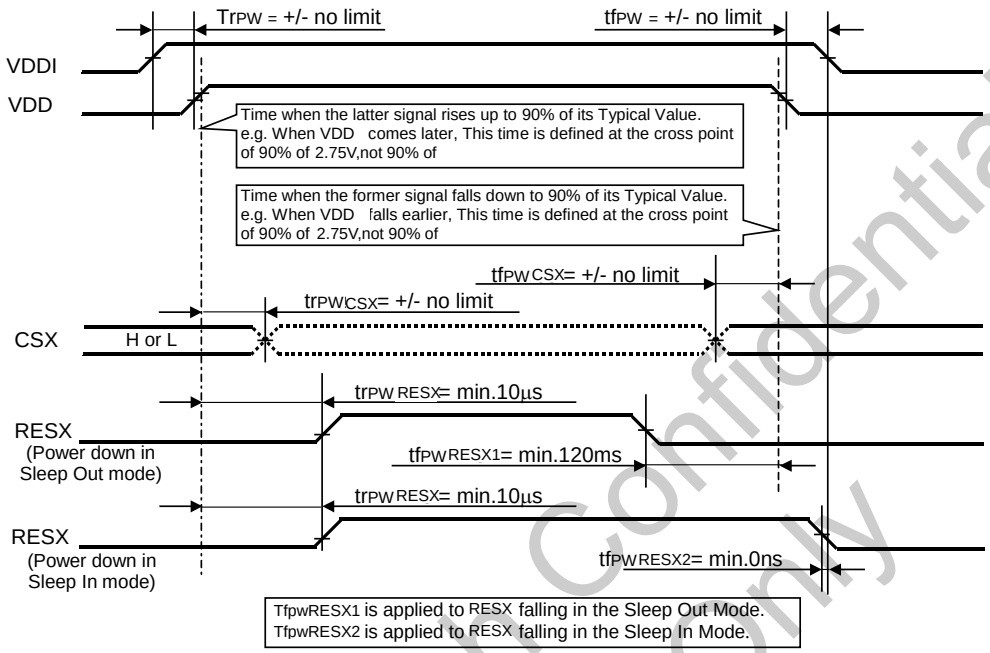
6.9.2. Case 2– RESX line is held low by host at power on

If RESX line is held Low (and stable) by the host during Power On, then the RESX must be held low for minimum 10μsec after both VDD and VDDIO have been applied.



Note: Unless otherwise specified, timings herein show cross point at 50% of signal/power level.

6.9.3. Uncontrolled power off

The uncontrolled power off means a situation when e.g. there is removed a battery without the controlled power off sequence. There will not be any damages for the display module or the display module will not cause any damages for the host or lines of the interface.

At an uncontrolled power off the display will go blank and there will not be any visible effects within (TBD) second on the display (blank display) and remains blank until “Power On Sequence” powers it up.

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6.10. Power Level Definition

6.10.1. Power level

6 level modes are defined they are in order of Maximum Power consumption to Minimum Power Consumption:

1. Normal Mode On (full display), Idle Mode Off, Sleep Out.

In this mode, the display is able to show maximum 262,144 colors.

2. Partial Mode On, Idle Mode Off, Sleep Out.

In this mode part of the display is used with maximum 262,144 colors.

3. Normal Mode On (full display), Idle Mode On, Sleep Out.

In this mode, the full display area is used but with 8 colors.

4. Partial Mode On, Idle Mode On, Sleep Out.

In this mode, part of the display is used but with 8 colors.

5. Sleep In Mode

In this mode, the DC: DC converter, Internal oscillator and panel driver circuit are stopped. Only the MCU interface and memory works with VDDIO power supply. Contents of the memory are safe.

6. Power Off Mode

In this mode, both VDD and VDDIO are removed.

Note: Transition between modes 1-5 is controllable by MCU commands. Mode 6 is entered only when both Power supplies are removed.

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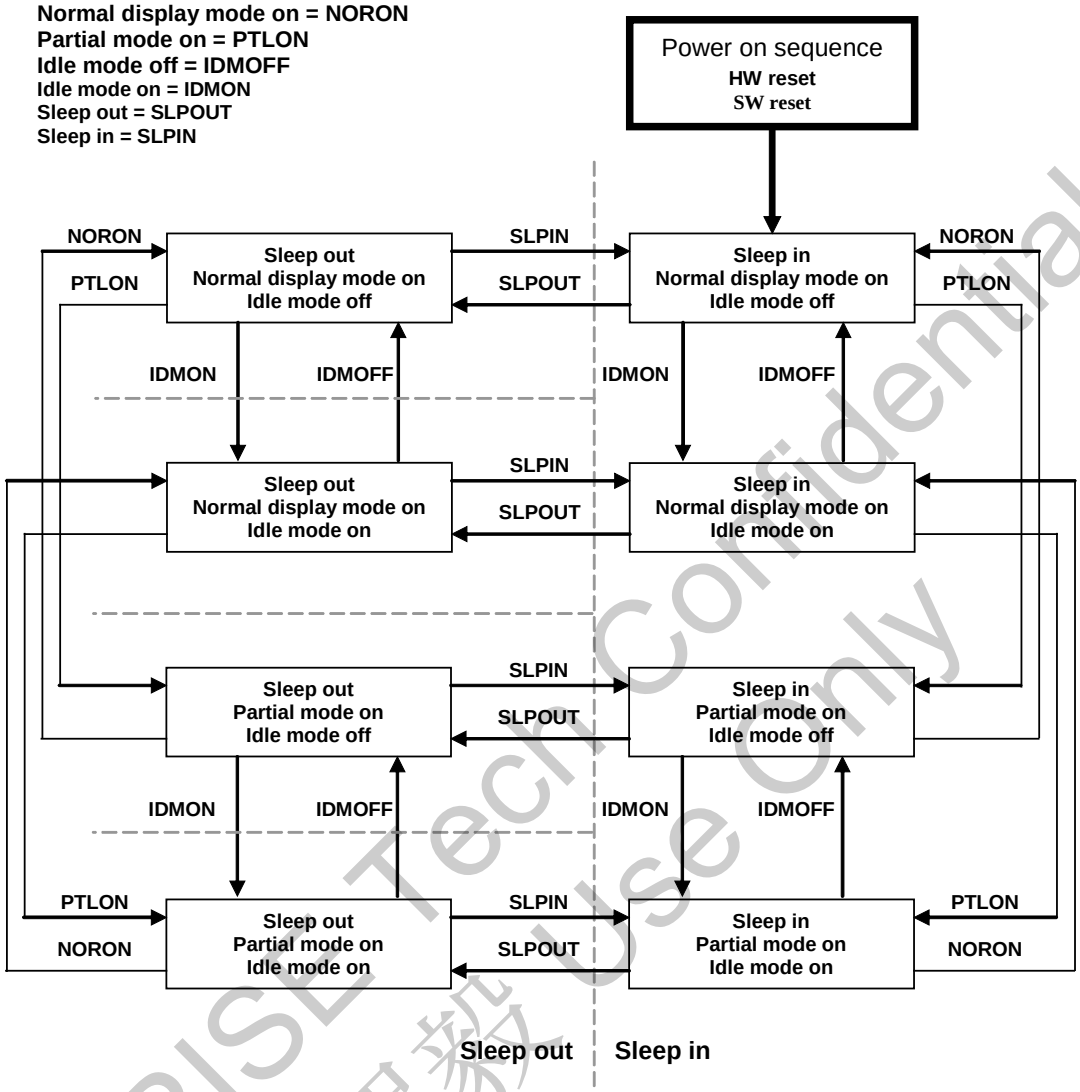
6.10.2. Power flow chart

Normal display mode on = NORON
Partial mode on = PTLON
Idle mode off = IDMOFF
Idle mode on = IDMON
Sleep out = SLPOUT
Sleep in = SLPIN



Note 1: There is not any abnormal visual effect when there is changing from one power mode to another power mode.

Note 2: There is not any limitation, which is not specified by this spec, when there is changing from one power mode to another power mode.

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6.11. Tear Effect Information

6.11.1. General

The MCU is updating the frame memory of the display module via its interface (DSI).

The display module is refreshing the display panel from the frame memory independently and it does not know what is happening on the interface of the display module (The MCU is sending image information to the display module). It is possible that this asynchronous updating is causing an abnormal visual effect on the display panel of the display module.

Therefore, the display module is sending a synchronous information (= Tearing Effect Information), which is telling the position of the refreshing on the display panel, to the MCU which can decide when it can send image information to the display module (Mainly used for a moving image e.g. video clips) that there can avoid the abnormal visual effect on the display panel of the display module.

This Tearing Effect information can be sent in two different ways:

• Separated Line, which is so-called Tearing Effect (TE) line

• Bus, which is so-called Tearing Effect (TEE) Bus Trigger, when the display module is sending a trigger to the MCU

The TE line can be used in DSI case if the Tearing Effect (TEE) bus trigger is not possible to use and the Tearing Effect (TEE) Bus Trigger is only used in DSI case.

6.11.1.1. Tearing effect line models

The Tearing Effect line supplies to the MCU a Panel synchronisation signal and this signal can be enabled or disabled by the Tearing Effect Line Off & On commands.

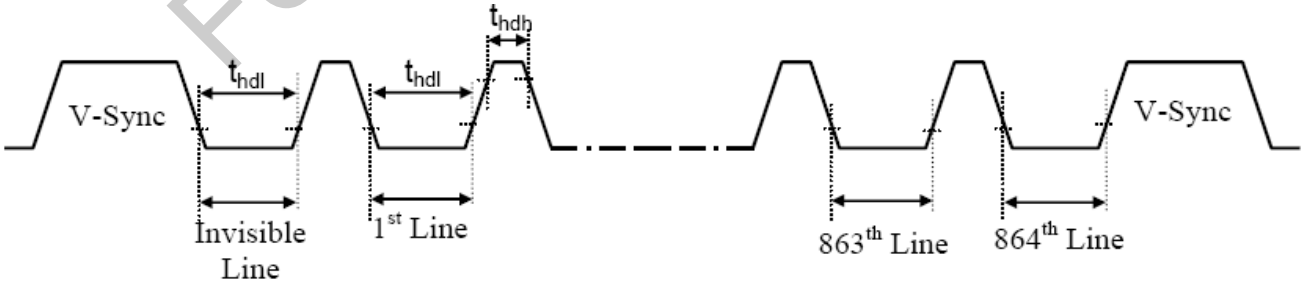
The mode of the Tearing Effect Signal is defined by the Parameter of the Tearing Effect Line On command.

Mode 1：The Tearing Effect Output signal consists of V-Sync information only:

t_{vdh} = The display panel is not updated from the Frame Memory.

t_{vdl} = The display panel is updated from the Frame Memory (except Invisible Line – see below).

Mode 2：The Tearing Effect Output signal consists of V-Sync and H-Sync information; There is one V-sync and 864 H-sync pulses per field:



t_{vdh} = The display panel is not updated from the Frame Memory.

t_{vdl} = The display panel is updated from the Frame Memory (except Invisible Line – see below).

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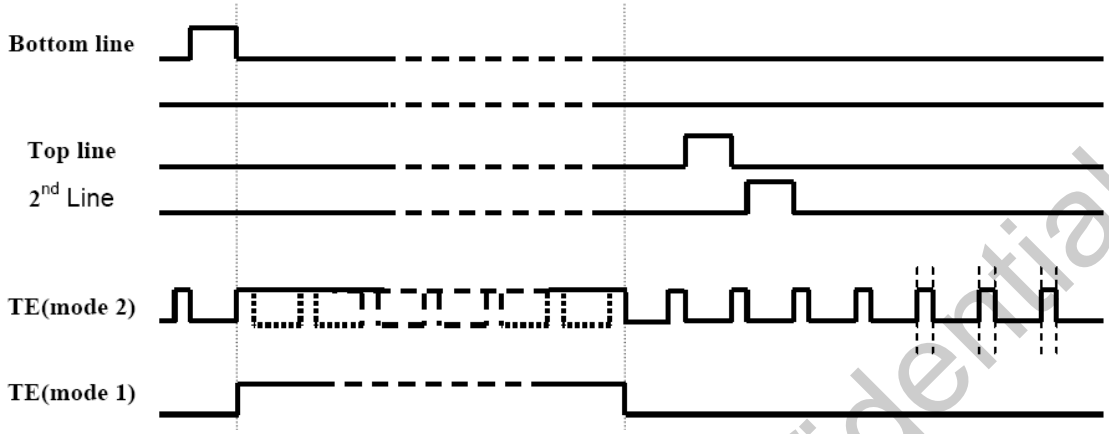
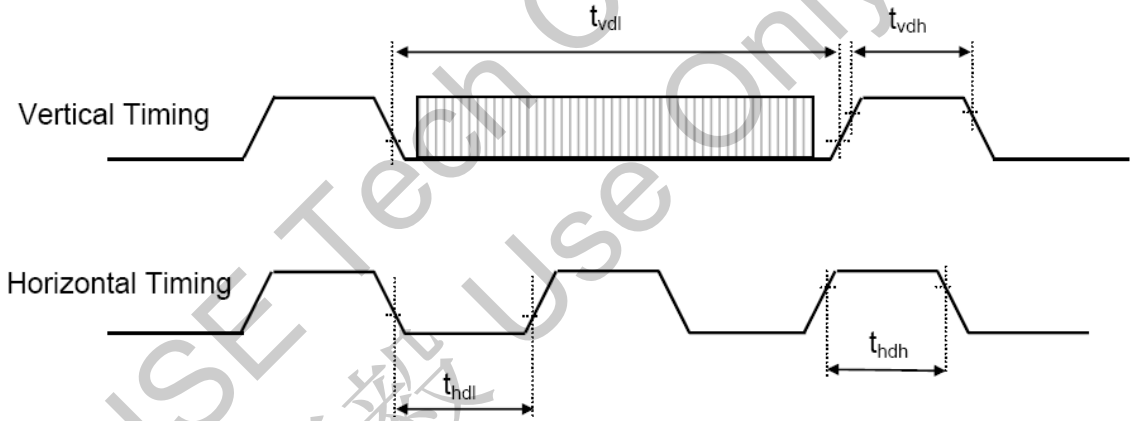
TE Line mode1 and Mode2 is shown as below graph:



Note: During Sleep In Mode, the Tearing Effect Output Pin is active Low.

6.11.1.2. Tearing effect line timing

The Tearing Effect signal is described below:



Idle Mode Off/On

Symbol	Parameter	Min.	Max.	Unit
t_{vdl}	Vertical Timing Low Duration			ms
t_{vdh}	Vertical Timing High Duration	1000		µs
t_{hdl}	Horizontal Timing Low Duration		-	µs
t_{hdh}	Horizontal Timing High Duration		500	µs

1. Minimum frequency of the TE-line cannot be less than 25Hz, when the TE-line is active, on Mode 1.
2. The signal's rise and fall times (tf, tr) are stipulated to be equal to or less than 15ns when the maximum load is TBD Ω.

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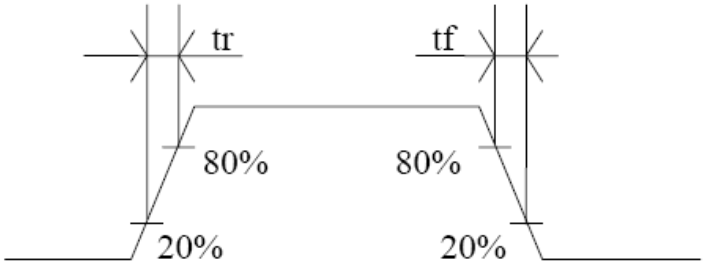
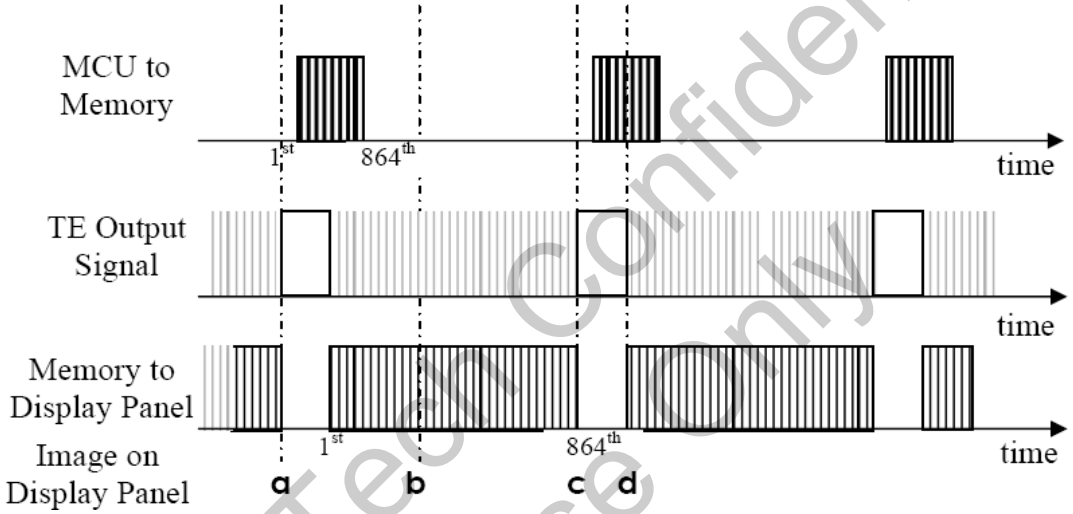
The TE signal rising and falling timing is described below:

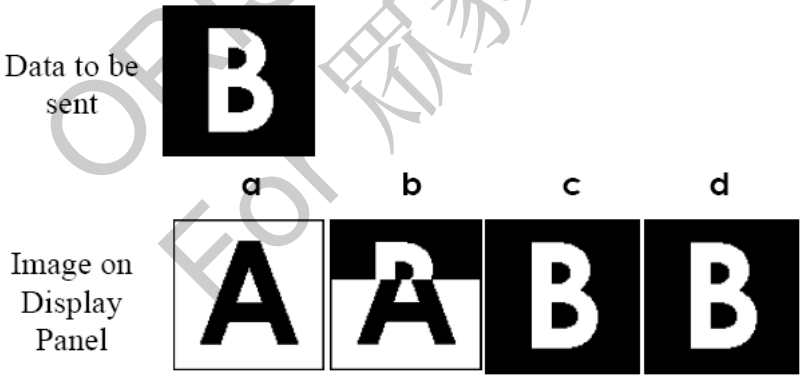


6.11.1.3. Example 1 MCU write is faster then panel read



MCU write is faster then panel read

Data write to Frame Memory is now synchronised to the Panel Scan. It should be written during the vertical sync pulse of the Tearing Effect Output Line. This ensures that data is always written ahead of the panel scan and each Panel Frame refresh has a complete new image:



Example 1 – Image on the display panel

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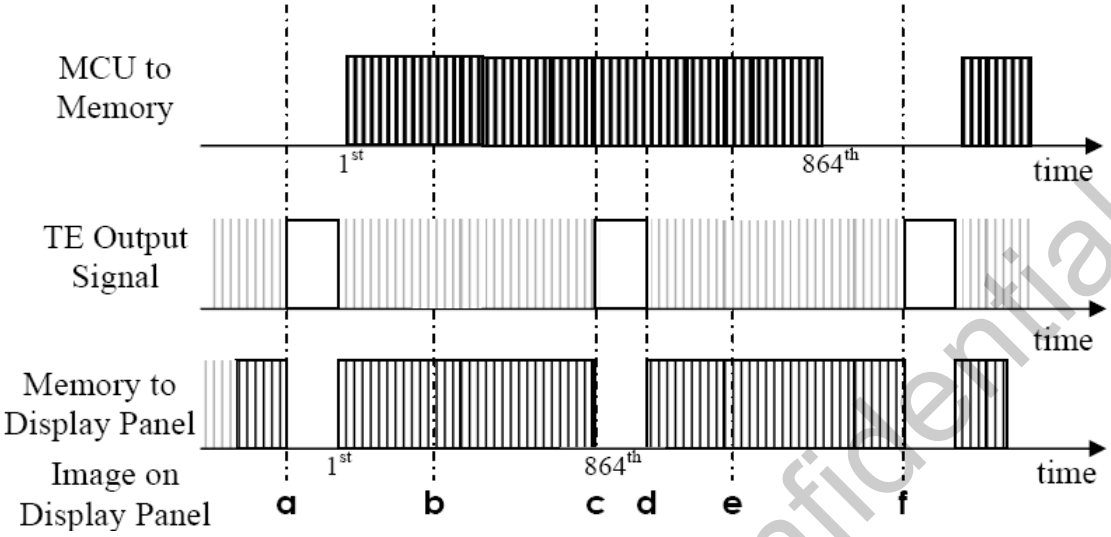
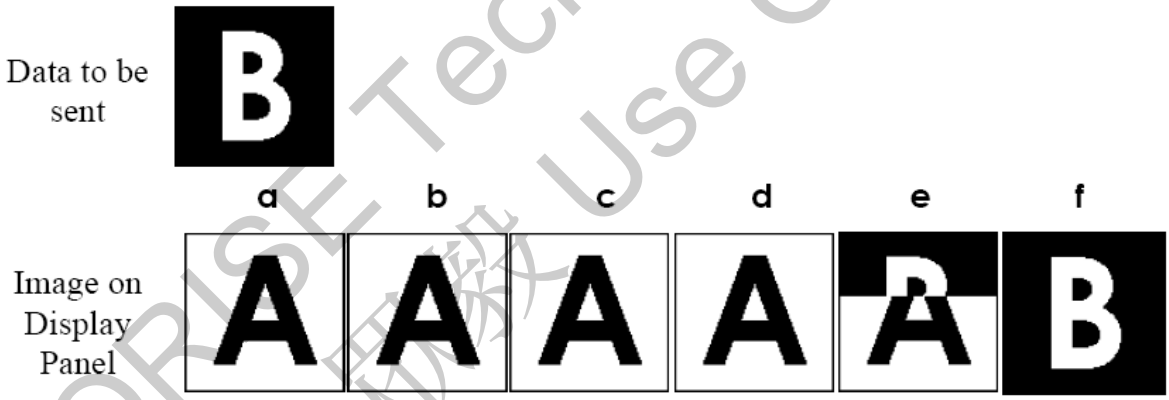
6.11.1.4. Example 1 MCU write is slower then panel read



MCU write is faster then panel read

The MCU to Frame Memory write begins just after Panel Read has commenced i.e. after one horizontal sync pulse of the Tearing Effect Output Line. This allows time for the image to download behind the Panel Read pointer and finishing download during the subsequent frame before the Read Pointer “catches” the MCU to frame memory write position.



Example 2 – Image on the display panel

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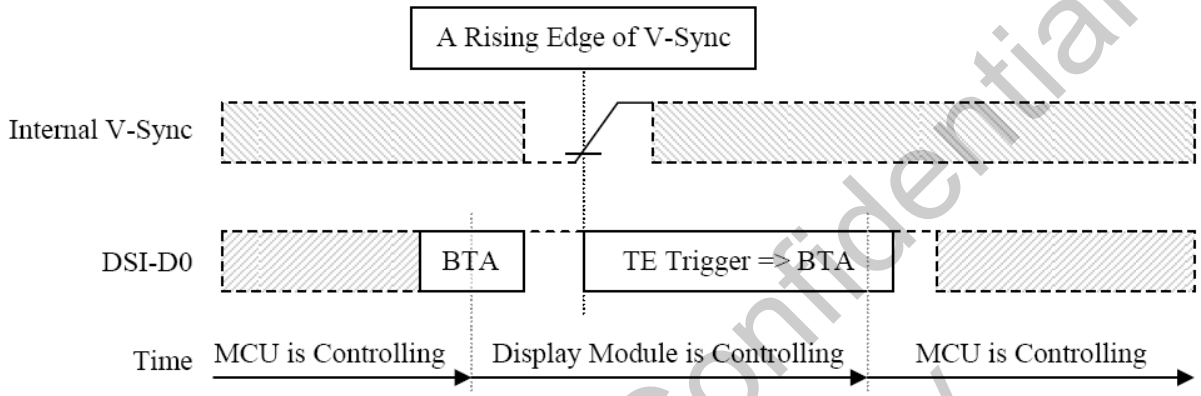
6.11.2. Tearing effect bus trigger

A Tearing Effect Bus Trigger information supplies to the MCU a Panel synchronisation trigger and this Tearing Effect Bus Trigger information can be enabled or disabled by commands “Tearing Effect Line Off (34h)” and “Tearing Effect Line On (35h)” when the only mode of the Tearing Effect Signal is VSync. information.

The display module is sending this trigger information in Escape Mode after the Bus Turnaround (BTA). The Tearing Effect Bus Trigger can only use in DSI case without the TE line.



A rising edge of the V-Sync and DSI-D0

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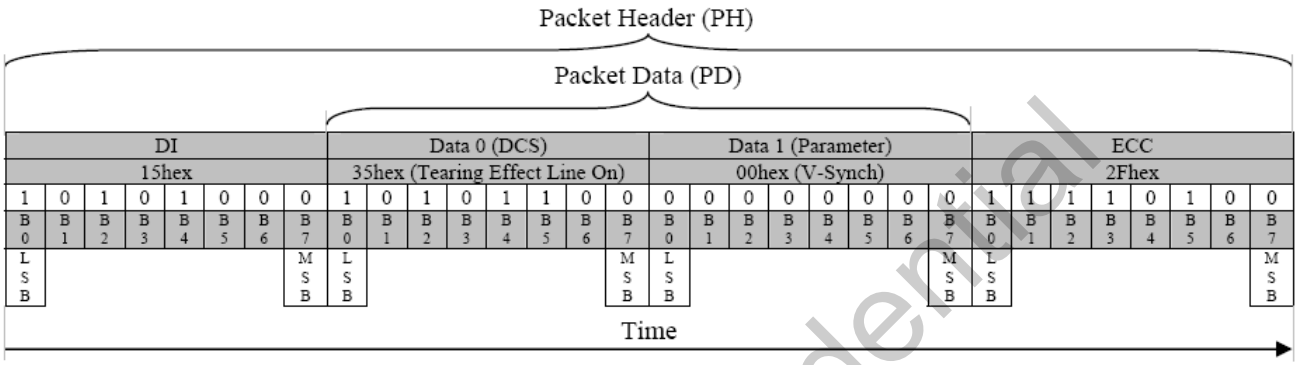
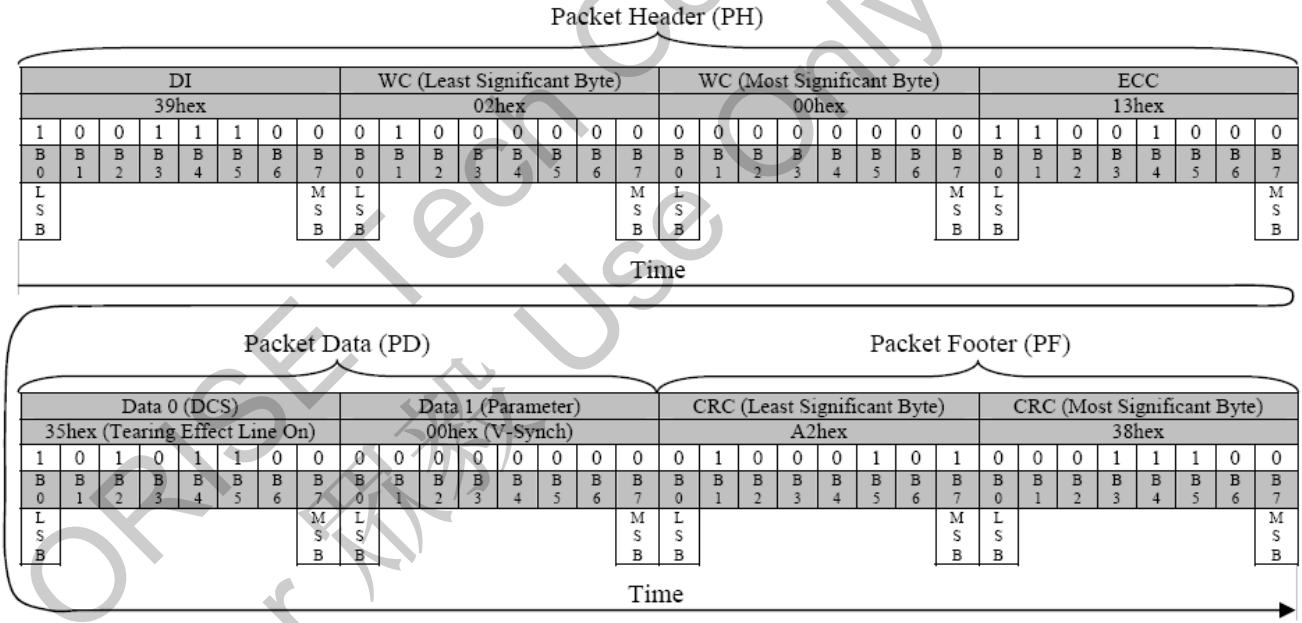
6.11.2.1. Tearing effect bus trigger enable

The MCU can enable the Tearing Effect Bus Trigger on the display module in 2 different ways when a Short Packet (SPa) or Long Packet (LPa) is used. These cases are illustrated below.



Tearing effect bus trigger enable (DCSW1-S) – short packet (SPa)



Tearing effect bus trigger enable (DCSW-L) – long packet (LPa)

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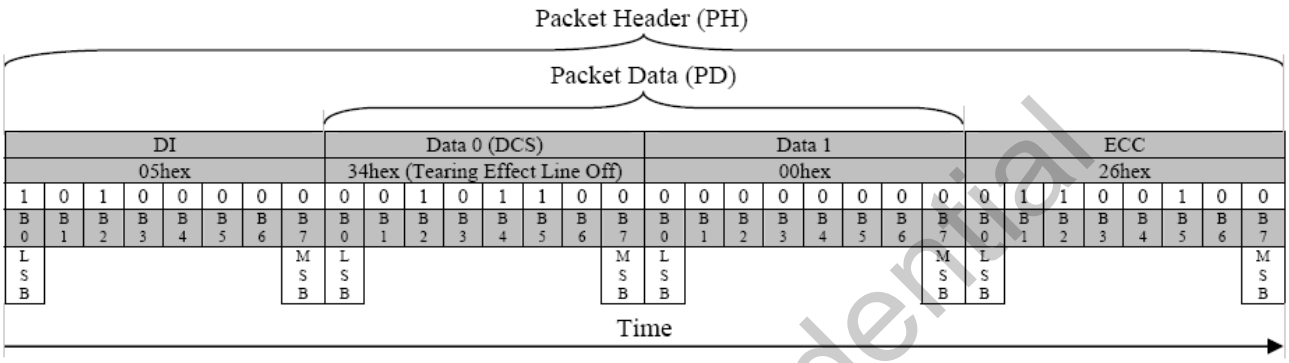
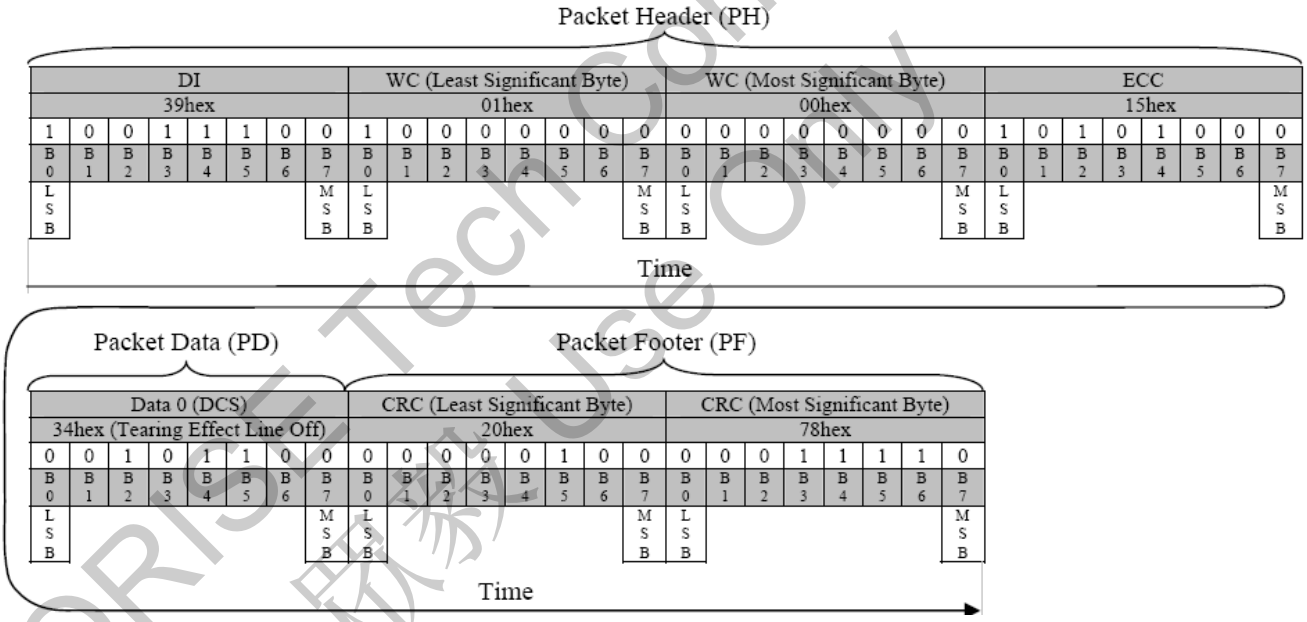
6.11.2.2. Tearing effect bus trigger disable

The MCU can enable the Tearing Effect Bus Trigger on the display module in 2 different ways when a Short Packet (SPa) or Long Packet (LPa) is used. These both possibilities are illustrated below.



Tearing effect bus trigger disable (DCSWN-S) – short packet (SPa)



Tearing effect bus trigger disable (DCSW-L) – long packet (LPa)

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6.11.2.3. Tearing effect bus trigger sequences

6.11.2.4. Tearing effect bus trigger enable sequence – DCSW-L and HSDT

Line	MCU		Information Direction	Display Module		Comment
	Packet Sender	Interface Mode Control		Interface Mode Control	Packet Sender	
1	-	LP-11	=>	-	-	Start
2	DCSW-L	HSDT	=>	-	-	Tearing Effect Bus Trigger Enable
3	EoTP	HSDT	=>	-	-	End of Transmission Packet
4	-	LP-11	=>	-	-	
5	-	BTA	<=>	BTA	-	Interface Control Change from the MCU to the display module
6	-	-	<=	LP-11	-	If No Error => Goto Line 8 If Error is Corrected by ECC => Goto Line 19 If Error => Goto Line 30
7						
8	-	-	<=	ACK	-	No Error
9	-	-	<=	LP-11	-	
10	-	BTA	<=>	BTA	-	Interface Control Change from the display module to the MCU
11	-	LP-11	=>	-	-	
12	-	BTA	<=>	BTA	-	Interface Control Change from the MCU to the display module
13	-	-	<=	LP-11	-	
14	-	-	<=	TEE	-	TE (Escape Trigger) on the next V-Synch.
15	-	-	<=	LP-11	-	
16	-	BTA	<=>	BTA	-	Interface Control Change from the display module to the MCU
17	-	LP-11	=>	-	-	End
18						
19	-	-	<=	LPDT	AwER	Error Report (Error is Corrected by ECC)
20	-	-	<=	LP-11	-	
21	-	BTA	<=>	BTA	-	Interface Control Change from the display module to the MCU
22	-	LP-11	=>	-	-	
23	-	BTA	<=>	BTA	-	Interface Control Change from the MCU to the display module
24	-	-	<=	LP-11	-	
25	-	-	<=	TEE	-	TE (Escape Trigger) on the next V-Synch.
26	-	-	<=	LP-11	-	
27	-	BTA	<=>	BTA	-	Interface Control Change from the display module to the MCU
28	-	LP-11	=>	-	-	End
29						
30	-	-	<=	LPDT	AwER	Error Report
31	-	-	<=	LP-11	-	
32	-	BTA	<=>	BTA	-	Interface Control Change from the display module to the MCU
33	-	LP-11	=>	-	-	If the MCU is not forcing BTA => Goto Line 34 If the MCU is forcing BTA => Goto Line 36
34	-	LP-11	=>	-	-	End
35						
36	-	BTA	<=>	BTA	-	Interface Control Change from the MCU to the display module
37	-	-	<=	LP-11	-	Dead-Lock (No TE information) See Note 2
38	-	LP-11	=>	-	-	The MCU is forced to start to control the interface. The display module detects Bus Connection Error (BCE
39	-	BTA	<=>	BTA	-	Interface Control Change from the MCU to the display module
40	-	-	<=	LP-11	-	
41	-	-	<=	LPDT	AwER	Error Report (Bus Connection Error (BCE) is reported) See Note 2
42	-	-	<=	LP-11	-	
43	-	BTA	<=>	BTA	-	Interface Control Change from the display module to the MCU
44	-	LP-11	=>	-	-	End

Notes:

1. Lines 1 – 17 are needed for every frame..

2. Bits 5 and 7 of the AwER are applied.

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6.11.2.5. Tearing effect bus trigger enable sequence – DCSW-L and LPDT

Line	MCU		Information Direction	Display Module		Comment
	Packet Sender	Interface Mode Control		Interface Mode Control	Packet Sender	
1	-	LP-11	=>	-	-	Start
2	DCSW-L	LPDT	=>	-	-	Tearing Effect Bus Trigger Enable
3	-	LP-11	=>	-	-	
4	-	BTA	<=>	BTA	-	Interface Control Change from the MCU to the display module
5	-	-	<=	LP-11	-	If No Error => Goto Line 7 If Error is Corrected by ECC => Goto Line 18 If Error => Goto Line 29
6						
7	-	-	<=	ACK	-	No Error
8	-	-	<=	LP-11	-	
9	-	BTA	<=>	BTA	-	Interface Control Change from the display module to the MCU
10	-	LP-11	=>	-	-	
11	-	BTA	<=>	BTA	-	Interface Control Change from the MCU to the display module
12	-	-	<=	LP-11	-	
13	-	-	<=	TEE	-	TE (Escape Trigger) on the next V-Synch.
14	-	-	<=	LP-11	-	
15	-	BTA	<=>	BTA	-	Interface Control Change from the display module to the MCU
16	-	LP-11	=>	-	-	End
17						
18	-	-	<=	LPDT	AwER	Error Report (Error is Corrected by ECC)
19	-	-	<=	LP-11	-	
20	-	BTA	<=>	BTA	-	Interface Control Change from the display module to the MCU
21	-	LP-11	=>	-	-	
22	-	BTA	<=>	BTA	-	Interface Control Change from the MCU to the display module
23	-	-	<=	LP-11	-	
24	-	-	<=	TEE	-	TE (Escape Trigger) on the next V-Synch.
25	-	-	<=	LP-11	-	
26	-	BTA	<=>	BTA	-	Interface Control Change from the display module to the MCU
27	-	LP-11	=>	-	-	End
28						
29	-	-	<=	LPDT	AwER	Error Report
30	-	-	<=	LP-11	-	
31	-	BTA	<=>	BTA	-	Interface Control Change from the display module to the MCU
32	-	LP-11	=>	-	-	If the MCU is not forcing BTA => Goto Line 33 If the MCU is forcing BTA => Goto Line 35
33	-	LP-11	=>	-	-	End
34						
35	-	BTA	<=>	BTA	-	Interface Control Change from the MCU to the display module
36	-	-	<=	LP-11	-	Dead-Lock (No TE information) See Note 2
37	-	LP-11	=>	-	-	The MCU is forced to start to control the interface. The display module detects Bus Connection Error (BCE)
38	-	BTA	<=>	BTA	-	Interface Control Change from the MCU to the display module
39	-	-	<=	LP-11	-	
40	-	-	<=	LPDT	AwER	Error Report (Bus Connection Error (BCE) is reported) See Note 2
41	-	-	<=	LP-11	-	
42	-	BTA	<=>	BTA	-	Interface Control Change from the display module to the MCU
43	-	LP-11	=>	-	-	End

Notes:

1. Lines 1 – 16 are needed for every frame.

2. Bits 5 and 7 of the AwER are applied.

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6.11.2.6. Tearing effect bus trigger enable sequence – DCSW1-S and HPDT

Line	MCU		Information Direction	Display Module		Comment
	Packet Sender	Interface Mode Control		Interface Mode Control	Packet Sender	
1	-	LP-11	=>	-	-	Start
2	DCSW1-S	HSDT	=>	-	-	Tearing Effect Bus Trigger Enable
3	EoTP	HSDT	=>	-	-	End of Transmission Packet
4	-	LP-11	=>	-	-	
5	-	BTA	<=>	BTA	-	Interface Control Change from the MCU to the display module
6	-	-	<=	LP-11	-	If No Error => Goto Line 8 If Error is Corrected by ECC => Goto Line 19 If Error => Goto Line 30
7						
8	-	-	<=	ACK	-	No Error
9	-	-	<=	LP-11	-	
10	-	BTA	<=>	BTA	-	Interface Control Change from the display module to the MCU
11	-	LP-11	=>	-	-	
12	-	BTA	<=>	BTA	-	Interface Control Change from the MCU to the display module
13	-	-	<=	LP-11	-	
14	-	-	<=	TEE	-	TE (Escape Trigger) on the next V-Synch.
15	-	-	<=	LP-11	-	
16	-	BTA	<=>	BTA	-	Interface Control Change from the display module to the MCU
17	-	LP-11	=>	-	-	End
18						
19	-	-	<=	LPDT	AwER	Error Report (Error is Corrected by ECC)
20	-	-	<=	LP-11	-	
21	-	BTA	<=>	BTA	-	Interface Control Change from the display module to the MCU
22	-	LP-11	=>	-	-	
23	-	BTA	<=>	BTA	-	Interface Control Change from the MCU to the display module
24	-	-	<=	LP-11	-	
25	-	-	<=	TEE	-	TE (Escape Trigger) on the next V-Synch.
26	-	-	<=	LP-11	-	
27	-	BTA	<=>	BTA	-	Interface Control Change from the display module to the MCU
28	-	LP-11	=>	-	-	End
29						
30	-	-	<=	LPDT	AwER	Error Report
31	-	-	<=	LP-11	-	
32	-	BTA	<=>	BTA	-	Interface Control Change from the display module to the MCU
33	-	LP-11	=>	-	-	If the MCU is not forcing BTA => Goto Line 34 If the MCU is forcing BTA => Goto Line 36
34	-	LP-11	=>	-	-	End
35						
36	-	BTA	<=>	BTA	-	Interface Control Change from the MCU to the display module
37	-	-	<=	LP-11	-	Dead-Lock (No TE information) See Note 2
38	-	LP-11	=>	-	-	The MCU is forced to start to control the interface. The display module detects Bus Connection Error (BCE)
39	-	BTA	<=>	BTA	-	Interface Control Change from the MCU to the display module
40	-	-	<=	LP-11	-	
41	-	-	<=	LPDT	AwER	Error Report (Bus Connection Error (BCE) is reported) See Note 2
42	-	-	<=	LP-11	-	
43	-	BTA	<=>	BTA	-	Interface Control Change from the display module to the MCU
44	-	LP-11	=>	-	-	End

Notes:

1. Lines 1 – 17 are needed for every frame.

2. Bits 5 and 7 of the AwER are applied.

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6.11.2.7. Tearing effect bus trigger enable sequence – DCSW1-S and LPDT

Line	MCU		Information Direction	Display Module		Comment
	Packet Sender	Interface Mode Control		Interface Mode Control	Packet Sender	
1	-	LP-11	=>	-	-	Start
2	DCSW1-S	LPDT	=>	-	-	Tearing Effect Bus Trigger Enable
3	-	LP-11	=>	-	-	
4	-	BTA	<=>	BTA	-	Interface Control Change from the MCU to the display module
5	-	-	<=	LP-11	-	If No Error => Goto Line 7 If Error is Corrected by ECC => Goto Line 18 If Error => Goto Line 29
6						
7	-	-	<=	ACK	-	No Error
8	-	-	<=	LP-11	-	
9	-	BTA	<=>	BTA	-	Interface Control Change from the display module to the MCU
10	-	LP-11	=>	-	-	
11	-	BTA	<=>	BTA	-	Interface Control Change from the MCU to the display module
12	-	-	<=	LP-11	-	
13	-	-	<=	TEE	-	TE (Escape Trigger) on the next V-Synch.
14	-	-	<=	LP-11	-	
15	-	BTA	<=>	BTA	-	Interface Control Change from the display module to the MCU
16	-	LP-11	=>	-	-	End
17						
18	-	-	<=	LPDT	AwER	Error Report (Error is Corrected by ECC)
19	-	-	<=	LP-11	-	
20	-	BTA	<=>	BTA	-	Interface Control Change from the display module to the MCU
21	-	LP-11	=>	-	-	
22	-	BTA	<=>	BTA	-	Interface Control Change from the MCU to the display module
23	-	-	<=	LP-11	-	
24	-	-	<=	TEE	-	TE (Escape Trigger) on the next V-Synch.
25	-	-	<=	LP-11	-	
26	-	BTA	<=>	BTA	-	Interface Control Change from the display module to the MCU
27	-	LP-11	=>	-	-	End
28						
29	-	-	<=	LPDT	AwER	Error Report
30	-	-	<=	LP-11	-	
31	-	BTA	<=>	BTA	-	Interface Control Change from the display module to the MCU
32	-	LP-11	=>	-	-	If the MCU is not forcing BTA => Goto Line 33 If the MCU is forcing BTA => Goto Line 35
33	-	LP-11	=>	-	-	End
34						
35	-	BTA	<=>	BTA	-	Interface Control Change from the MCU to the display module
36	-	-	<=	LP-11	-	Dead-Lock (No TE information) See Note 2
37	-	LP-11	=>	-	-	The MCU is forced to start to control the interface. The display module detects Bus Connection Error (BCE)
38	-	BTA	<=>	BTA	-	Interface Control Change from the MCU to the display module
39	-	-	<=	LP-11	-	
40	-	-	<=	LPDT	AwER	Error Report (Bus Connection Error (BCE) is reported) See Note 2
41	-	-	<=	LP-11	-	
42	-	BTA	<=>	BTA	-	Interface Control Change from the display module to the MCU
43	-	LP-11	=>	-	-	End

Notes:

1. Lines 1 – 16 are needed for every frame.

2. Bits 5 and 7 of the AwER are applied.

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6.11.2.8. Tearing effect bus trigger enable sequence – DCSWN-S and HPDT

Line	MCU		Information Direction	Display Module		Comment
	Packet Sender	Interface Mode Control		Interface Mode Control	Packet Sender	
1	-	LP-11	=>	-	-	Start
2	DCSWN-S	HSDT	=>	-	-	Tearing Effect Bus Trigger Disable
3	EoTP	HSDT	=>	-	-	End of Transmission Packet
4	-	LP-11	=>	-	-	End

6.11.2.9. Tearing effect bus trigger enable sequence – DCSWN-S and LPDT

Line	MCU		Information Direction	Display Module		Comment
	Packet Sender	Interface Mode Control		Interface Mode Control	Packet Sender	
1	-	LP-11	=>	-	-	Start
2	DCSWN-S	LPDT	=>	-	-	Tearing Effect Bus Trigger Disable
3	-	LP-11	=>	-	-	End

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6.12. Checksum

The display module consists of two 8-bit checksum registers, which are used checksum calculations for area registers (includes the frame memory), on the display module. Area registers are registers which values can change a command directly. One of the checksum registers is “First Checksum” (FCS) and another is “Continue Checksum” (CCS). These register values are set to 00h as an initial value when there is started to calculate a new checksum. The display module is starting to calculate the new checksum after there is a write access on area registers. This means that read commands are not used as a calculation starting trigger in this case. The checksum calculation is always interrupted, when there is a new write access on area registers. The checksum calculation is also started from the beginning. The result of the first finished checksum calculation is stored on the FCS register, which value is kept until there is the new write access on area registers and the new checksum value is calculated in the first time again.

The maximum time, when the FCS is readable, is 150ms after there is the last write access on area registers.
The checksum calculation is continuing after the finished first checksum calculation where the FCS has gotten the checksum value. These new checksum values are always stored on CCS register (Old value is replaced a new one) after the last area register has been calculated to the checksum.

The maximum time, when the CCS is readable in the first time, is 300ms after there is the last write access on area registers.
There is always updated a checksum comparison bit (See command “Read Display Self-Diagnostic Result (0FH)” and bit D0) when there is compared FCS and CCS checksums after a new checksum value is stored on CCS.

The maximum time, when the comparison has been done between FCS and CCS in the first time, is 300ms then the comparison has been done in every 150ms (this is maximum time). Area can read FCS, CCS and Comparison bit D0 values. See command: “Read First Checksum (AAH)”, “Read Continue Checksum (AFH)” and ”Read Display Self-Diagnostic Result (0FH)”.

There can be an overflow during a checksum calculation. These overflow bits are not needed to store anywhere. This means that these overflow bits can be ignored by the display module.

An example of the checksum calculation:

- Register Values: A1h, 12h, 81h, DEh, F2h
- Calculated Value: 304h (= A1h + 12h + 81h + DEh + F2h)
- Ignored Bits: 3h
- Stored Checksum: 04h

This checksum calculation function is only running in “Sleep Out” mode and it is stopped in “Sleep In” mode.

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Checksum Sequence

Step Note 1	Time Note 2	Action	Temporary Register	First Checksum Register (FCS)	Continue Checksum Register (CCS)	Comment
1	0	Initialization	Set to 00h	Set to 00h	Set to 00h	The last write action on Nokia area registers => FCS and CCS registers are initialized.
2	0 – 150ms	Counting Sum of Nokia Area Registers	Counting	-	-	The first register counting is running
3	150ms	Stores Sum of Registers on FCS Register	Set to 00h after Value is Moved to FCS Register	Stores Sum of Nokia Area Registers on FCS Register	-	The result of the first register counting is stored on the FCS register. The result of the FCS is available to the MCU.
4	150 – 300ms	Counting Sum of Nokia Area Registers	Counting	-	-	The second register counting is running
5	300ms	1) Stores Sum of Registers on CCS Register 2) Compares Stored FCS and CCS Values	Set to 00h after Value is Moved to CCS Register	-	Stores Sum of Nokia Area Registers on CCS Register	The result of the comparison is stored on separated registers, which can read separated read commands. The result of the CCS and comparison result are available to the MCU.
6	300 – 450ms	Counting Sum of Nokia Area Registers	Counting	-	-	The third register counting is running
7	450ms	1) Stores Sum of Registers on CCS Register 2) Compares Stored FCS and CCS Values	Set to 00h after Value is Moved to CCS Register	-	Stores Sum of Nokia Area Registers on CCS Register	The result of the comparison is stored on separated registers, which can read separated read commands. The latest result of the CCS and comparison result are available to the MCU.
8	450 – 600ms	Counting Sum of Nokia Area Registers	Counting	-	-	The fourth register counting is running
9	600ms	1) Stores Sum of Registers on CCS Register 2) Compares Stored FCS and CCS Values	Set to 00h after Value is Moved to CCS Register	-	Stores Sum of Nokia Area Registers on CCS Register	The result of the comparison is stored on separated registers, which can read separated read commands. The latest result of the CCS and comparison result are available to the MCU.
10	etc	-	-	-	-	Same Sequence Countinue e.g. steps 4 and 5

Notes:

1. This function is restarted at Step 1 if there is any write action on area registers.

2. These time can be shorter on the display module.

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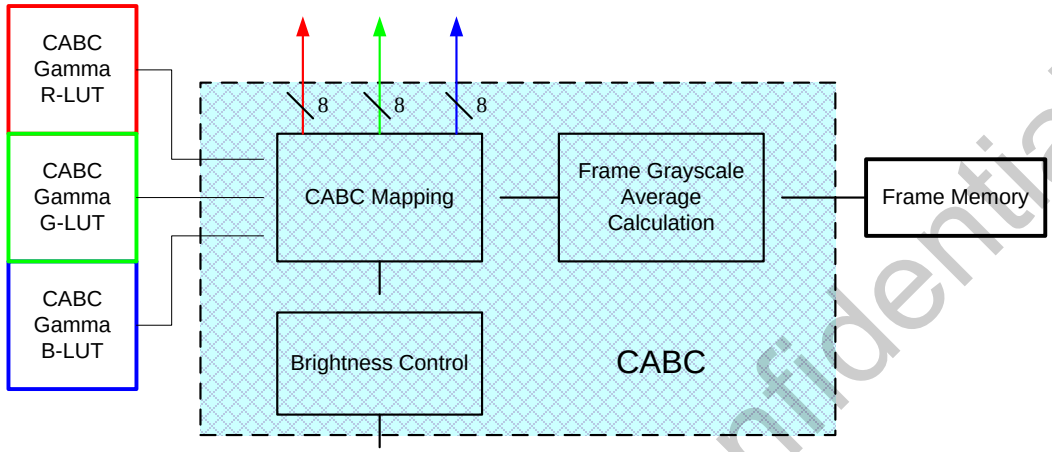
6.13. Content Adaptive Brightness Control (CABC)

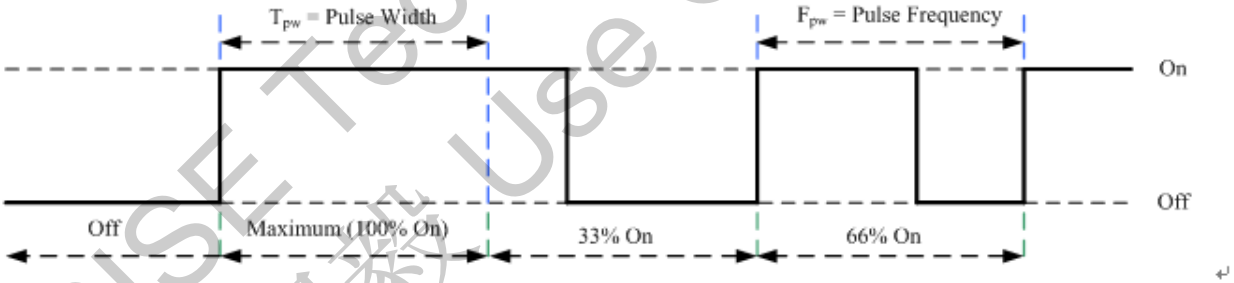
Content adaptation means that content grey level scale can be increased while simultaneously lowering brightness of the backlight to achieve same perceived brightness. CABC block diagram is shown as below:



PWM for BC

6.13.1. Backlight(BC) brightness control

Use the PWM output to control backlight. BC timing is described as below graph:



Symbol	Definition	MIN		Max.	Unit
t_{pw}	Pulse Width	0.033		8.33	ms
F_{pw}	PWM Frequency	38		39k	Hz

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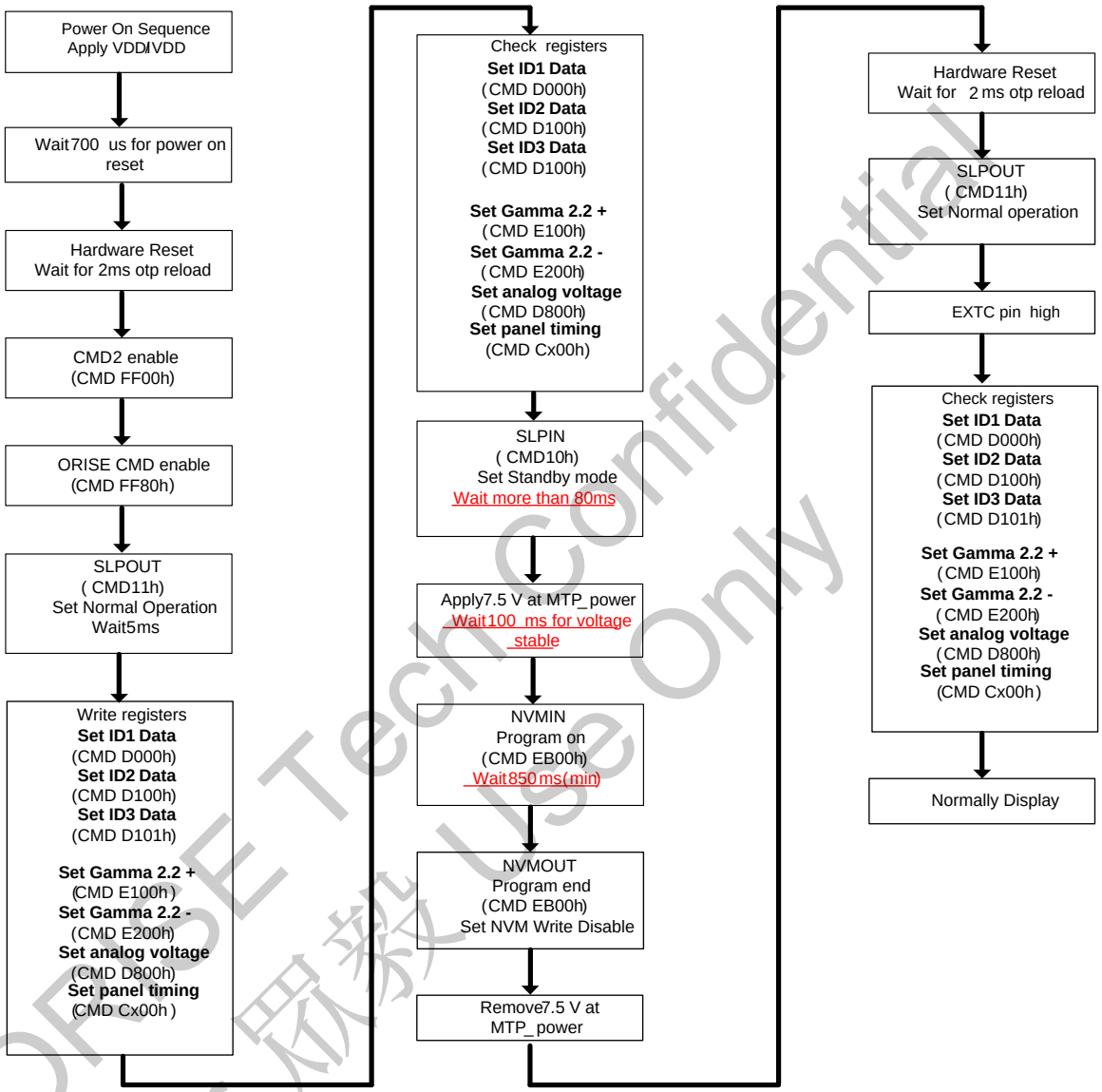
6.14. NVM Programming Procedure

6.14.1. NVM program flow chart



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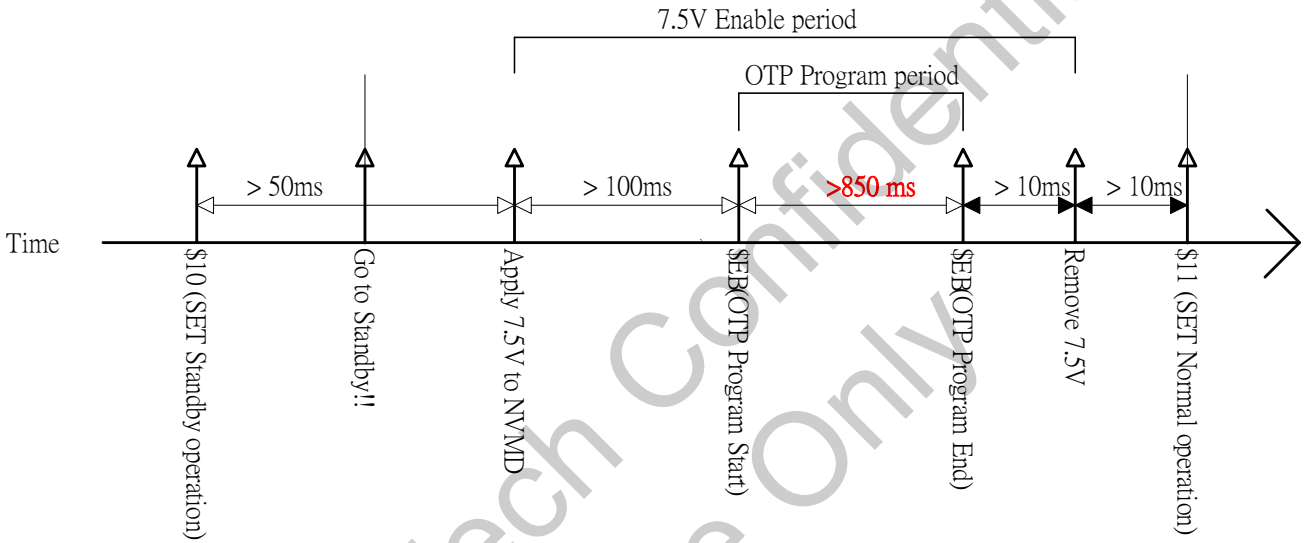
6.14.2. Programming sequence

Figure 6.9.1 shows the sequence about NVM. The first step to program NVM is “write Standby operation command”. After this command, over than 50ms must be hold to make sure that the dirver IC is in Standby mode. Another 100ms is necessary to make sure NVMD is stable to 7.5V. NVM program command can be written after stable 7.5V voltage existed. Then, NVM Program End command is written after **850ms**. 7.5V voltage is removed after Program End command, and then Normal operation command is written to verify the NVM memory.



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7. ELECTRICAL SPECIFICATIONS

7.1. Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Power Supply for I/O	VDDIO-VSS	-0.3~+4.5	V
Power Supply for HISSI Interface	VDDAM-AVSS	-0.3~+6.0	V
Power Supply for logic power regulator	VCC-VSS	-0.3~+6.0	V
Power Supply for Analog circuit	VDD-AVSS	-0.3~+6.0	V
Power Supply for OTP	MTP_PWR-AVSS	-0.3~+7.8	V
I/O input Voltage	Vt	-0.3~VDDIO+0.3	V
Driver output voltage	VGH-VGL	-0.3~+32	V
Differential Input Voltage	HSSI_CLK_P/N HSSI_D0_P/N HSSI_D1_P/N	-0.3~1.8	V
Operating Temperature	Topr	-30~+70	℃
Storage Temperature	Tstg	-30~+85	℃

Note1. The maximum applicable voltage on any pin with respect to 0V.

Note2. Device is subject to be damaged permanently if stresses beyond those absolute maximum ratings listed above.

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7.2. DC characteristic

7.2.1. Basic DC characteristic

Parameter	Symbol	Conditions	Specification			Unit	Notes
			MIN	TYP	MAX		
Power & Operation Voltage							
Analog Operating voltage	VDD	Operating Voltage	2.3	2.8/3.7	4.8	V	
Logic Operating voltage	VDDIO	I/O supply voltage	1.65	1.8	3.3	V	
	VDDIOL		1.1	1.2	1.3	V	
Digital Operating voltage	VCC	Digital supply voltage	2.3	2.8/3.7	4.8	V	
Hissi interface Operating voltage	VDDAM	MIPI/MDDI supply voltage	2.3	2.8/3.7	4.8	V	
Input / Output							
Logic High level input voltage	VIH		0.7VDDIO	-	VDDIO	V	
Logic Low level input voltage	VIL	-	VSS	-	0.3VDDIO	V	
Logic High level output voltage	VOH	IOH = -1.0mA	0.8VDDIO	-	VDDIO	V	
Logic Low level output voltage	VOL	IOL = +1.0mA	VSS	-	0.2VDDIO	V	
Logic High level input current	IIH	Vin = VDDIO or VDDAM			1	μA	
Logic Low level input current	IIL	Vin = VDDIO or VDDAM	-1			μA	
VCOM Operation							
VCOMDC output voltage	VCOM		-3.475	-1.0	**0**	V	
Source Driver							
Gamma positive reference voltage	VGMP	VGMP<VDDA-0.01V	3.1125		**6.3**	V	
Gamma negative reference voltage	VGMN	VGMN>NVDDA-0.01V	-6.3		-3.1125	V	
Source output voltage	VSD		VGMN		VGMP		
Output deviation voltage (Source positive output channel)	V,dev	Sout >=+4.2V, Sout<=+0.8V		20	30	mV	
		+4.2V>Sout>+0.8V		15	20	mV	
Output deviation voltage (Source negative output channel)	V,dev	Sout <=-4.2V, Sout>=-0.8V		20	30	mV	
		-4.2V<Sout<-0.8V		15	20	mV	
Output offset voltage	V_{OFSET}				35	mv	
Reference Voltage							
Internal reference voltage	V_{REF}		1.96	2	2.04	V	
Booster operation							
1st booster output voltage	VDDA	Range =1xVDD~3xVDD			6.5	V	
	NVDDA	Range = -1xVDDA			-6.5	V	
2nd booster output voltage	VGH	Range=(2xVDDA-NVDDA) ~(3xVDDA-NVDDA)	11.5		19	V	
	VGL	Range=(NVDDA-VDDA) ~(2xNVDDA-VDDA)	-7		-16	V	
3rd booster output voltage	VCL	Range= -1xVDD	-2.3		-3.5	V	
OSC Frequency							
Oscillator Frequency(MCK) with 480x800 Mode	fosc11	Frame rate =70Hz	32.54	33.54	34.55	MHz	
	fosc12	Frame rate =65Hz	30.21	31.15	32.08	MHz	
	fosc13	Frame rate =60Hz	27.89	28.75	29.61	MHz	
	fosc14	Frame rate =55Hz	25.56	26.35	27.14	MHz	

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Parameter	Symbol	Conditions	Specification			Unit	Notes
			MIN	TYP	MAX		
	fosc15	Frame rate =50Hz	23.24	23.96	24.68	MHz	
	fosc16	Frame rate =45Hz	20.91	21.56	22.21	MHz	
	fosc17	Frame rate =40Hz	18.59	19.17	19.74	MHz	
	fosc18	Frame rate =35Hz	16.27	16.77	17.17	MHz	
Oscillator Frequency(PWM)	mosc		16.49	17	17.51	MHz	
Current consumption							
Sleep-IN mode (LP-11)	IPNL	RESX=High		80	215	uA	
	IDDI			5	10	uA	
Sleep-IN mode (ULPS)	IPNL	RESX=HIGH		25	65	uA	
	IDDI			5	10	uA	
Sleep-IN mode (MDDI, Hibernation)	IPNL	RESX=High		80	210	uA	
	IDDI			5	10	uA	

Note1. Device is subject to be damaged permanently if stresses beyond those absolute maximum ratings listed above.

Note2. Test condition is at 25℃ and without panel loading.

Note3. PWM frequency is reference the mosc.

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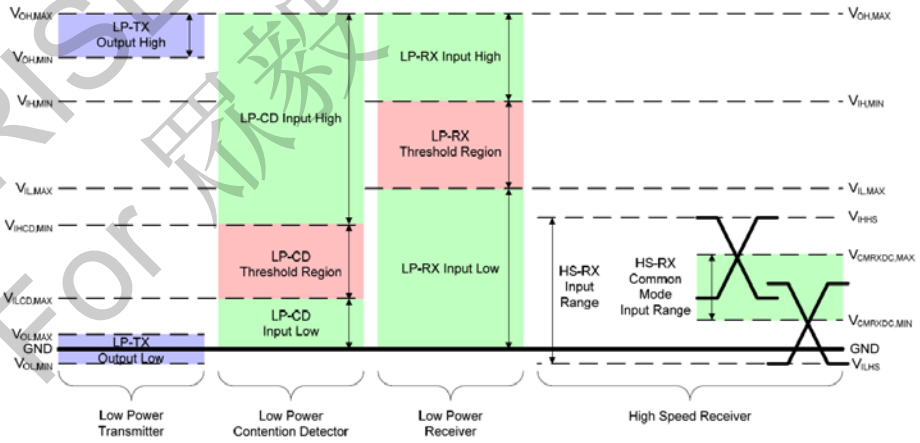
7.2.2. MIPI DC character

Table 7.2.2.1: DC characteristics for MIPI-DSI

Parameter	Symbol	Conditions	Specification			Unit
			MIN	TYP	MAX	
Power supply voltage for MIPI Interface						
Power supply voltage for MIPI interface	VDDAM	-	1.65	2.8	4.8	V
	VLPH	For LPDT	1.1	1.2	1.3	V
	VP_HISSI	-	1.5	1.55	1.6	V
LPDT Input Characteristics						
Pad signal voltage range	VI	-	-50	-	1350	mV
Ground Shift	VGNDSH	-	-50	-	50	mV
Logic 0 input threshold	VIL	-	0	-	550	mV
Logic 1 input threshold	VIH	-	880	-	VDDAM	mV
Input hysteresis	VHYST	-	25	-	-	mV
LPDT Output Characteristics						
Output low level	VOL	-	-50	-	50	mV
Output high level	VOH	-	1.1	1.2	1.3	V
Logic 1 contention threshold	VILCD,MIN	-	450	-	VDDAM	mV
Logic 0 contention threshold	VIHCD,MAX	-	0	-	200	mV
Output impedence of LPDT	ZOLP	-	80	100	125	ohm
Hi-speed Input/Output Characteristics						
Single-end input low voltage	VILHS	-	-40	-	-	mV
Single-end input high voltage	VIHHS	-	-	-	460	mV
Common mode voltage	VCMRXDC	-	70	-	330	mV
Hi-speed transmit voltage	VOD	-	140	200	250	mV
Differential input impedence	ZID	-	80	100	125	ohm



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7.2.3. MDDI DC character

Table 7.2.3.1: DC characteristics for MDDI

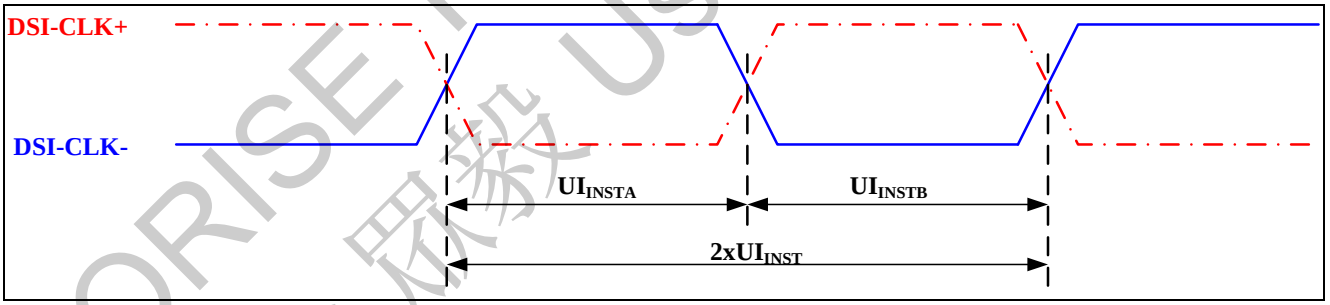
Parameter	Symbol	Conditions	Specification			Unit
			MIN	TYP	MAX	
Power supply voltage for MDDI interface	VDDAM	-	**1.65**	2.8	4.8	V
Data input high level voltage	VIT+off		-	100	125	mV
Data input low level voltage	VIT-off		75	100	-	mV
Data/Strobe input high level voltage	VIT+	VT=0V	-	0	50	mV
Data/Strobe input low level voltage	VIT-	VT=0V	-50	0	-	mV
Current consumption in Hibemation	Ihib	VDDAM=2.8V ; 550Mbps	-	40	-	uA
Current consumption in Data transfer	Itrans	VDDAM=2.8V ; 550Mbps	-	4	-	mA
Differential input impedence	Zt	-	80	100	125	Ohm

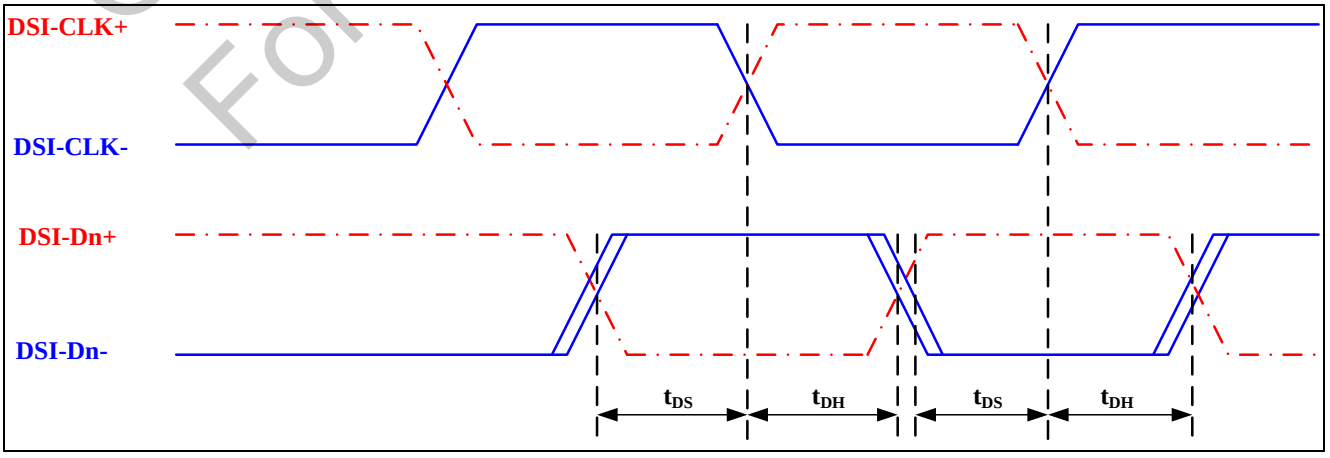
7.3. AC timing characteristics

7.3.1. MIPI-DSI characteristics

7.3.1.1. High speed mode

Parameter	Symbol	Parameter	Specification			Unit
			MIN	TYP	MAX	
High Speed mode						
DSI-CLK+/-	$2xUI_{INST}$	Double UI instantaneous	4	-	25	**ns**
DSI-CLK+/-	UI_{INSTA} , UI_{INSTB}	UI instantaneous Halfs	2	-	12.5	**ns**
DSI-Dn+/-	t_{DS}	Data to clock setup time	0.15	-	-	**UI**
DSI-Dn+/-	t_{DH}	Data to clock hold time	0.15	-	-	**UI**
DSI-CLK+/-	t_{DRTCLK}	Differential rise time for clock	150	-	0.3UI	**ps**
DSI-Dn+/-	$t_{DRTDATA}$	Differential rise time for data	150	-	0.3UI	**ps**
DSI-CLK+/-	t_{DFTCLK}	Differential fall time for clock	150	-	0.3UI	**ps**
DSI-Dn+/-	$t_{DFTDATA}$	Differential fall time for data	150	-	0.3UI	**ps**





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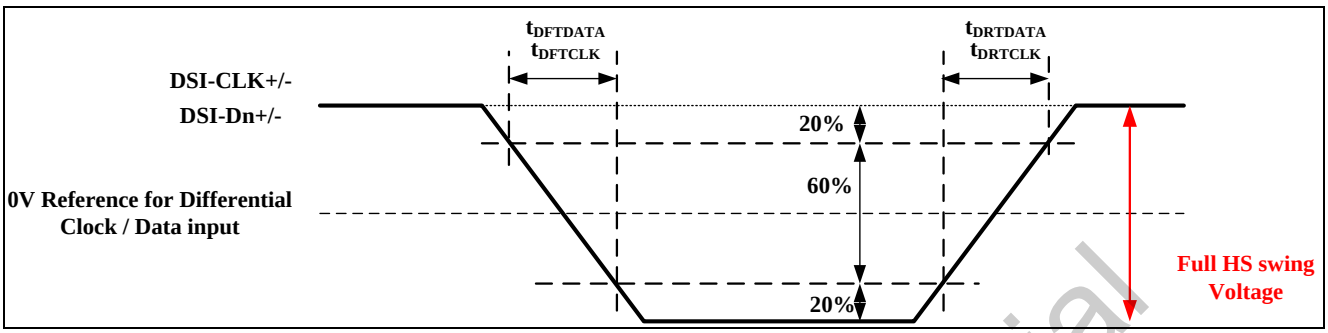

Fig. 7.3.1.1.1: AC characteristics for MIPI-DSI High speed mode

7.3.1.2. Low power mode

Parameter	Symbol	Parameter	Specification			Unit
			MIN	TYP	MAX	
Low Power mode						
DSI-D0+/-	T_{LPXM}	Length of LP-00, LP-01, LP-10 or LP-11 periods MPU → Display Module	50	-	-	ns
DSI-D0+/-	T_{LPXD}	Length of LP-00, LP-01, LP-10 or LP-11 periods Display Module → MPU	58	-	-	ns
DSI-D0+/-	$T_{TA-SURED}$	Time-out before the MPU start driving	T_{LPXD}	-	$2XT_{LPXD}$	ns
DSI-D0+/-	$T_{TA-GETD}$	Time to drive LP-00 by display module	$5XT_{LPXD}$	-	-	ns
DSI-D0+/-	T_{TA-GOD}	Time to drive LP-00 after turnaround request - MPU	$4XT_{LPXD}$	-	-	ns
DSI-D0+/-	Ratio T_{LPX}	Ratio of T_{LPXM} / T_{LPXD} between MCU and display module	2/3	-	3/2	

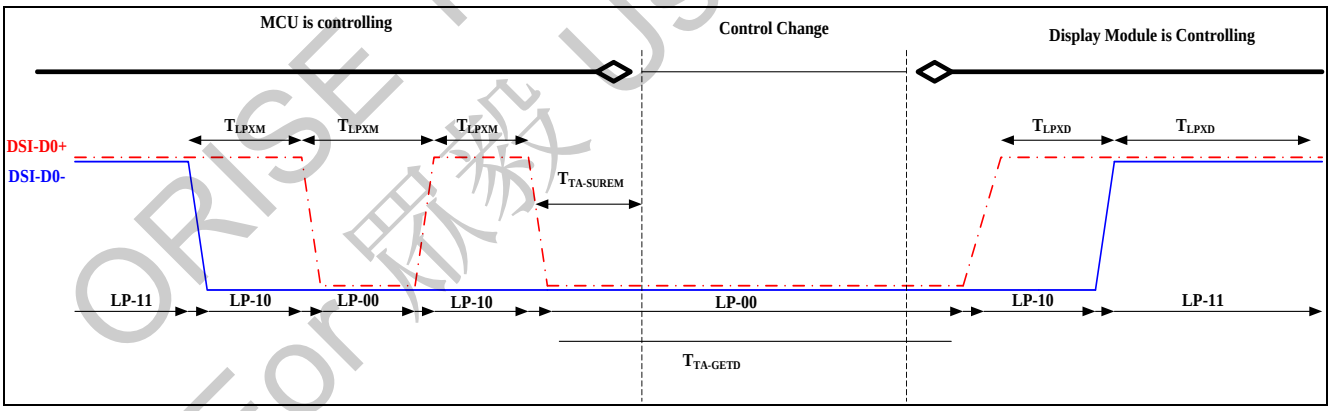

Fig. 7.3.1.2.1: BTA from the MCU to the Display Module

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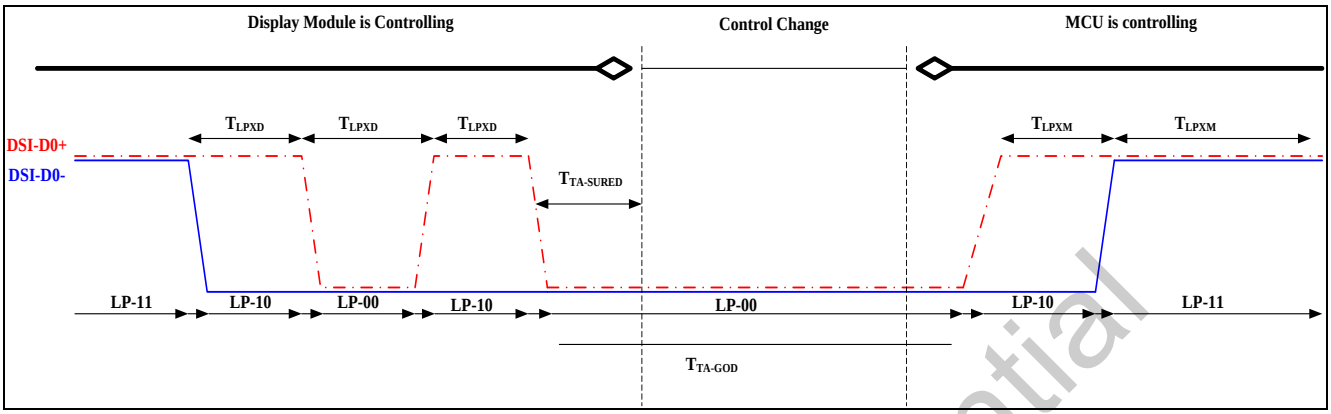

Fig. 7.3.1.2.2: BTA from the Display Module to the MCU

7.3.1.3. Bursts

Parameter	Symbol	Parameter	Specification			Unit
			MIN	TYP	MAX	
High Speed Data Transmission Bursts						
DSI-Dn+/-	T_{LPX}	Length of any low-power state period	50	-	-	ns
DSI-Dn+/-	$T_{HS-PREPARE}$	Time to drive LP-00 to prepare for HS transmission	40ns + 4UI	-	85ns + 6UI	ns
DSI-Dn+/-	$T_{HS-PREPARE}$ +$T_{HS-ZERO}$	$T_{HS-PREPARE}$ + time to drive HS-0 before the sync sequence	145ns + 10UI	-	-	ns
DSI-Dn+/-	$T_{D-TERM-EN}$	Time to enable Data Lane receiver line termination measured from when Dn crosses $V_{IL(max)}$	Time for Dn to reach $V_{TERM-EN}$	-	35ns + 4UI	ns
DSI-Dn+/-	$T_{HS-SKIP}$	Time-out at RX to ignore transition period of EoT	40	-	55ns + 4UI	ns
DSI-Dn+/-	$T_{HS-TRAIL}$	Time to drive flipped differential state after last payload data bit of a HS transmission burst	max (8UI, 60ns+4UI)	-	-	ns
DSI-Dn+/-	$T_{HS-EXIT}$	Time to drive LP-11 after HS burst	100	-	-	ns
DSI-Dn+/-	T_{EoT}	Time from start of $T_{HS-TRAIL}$ period to start of LP-11 state	-	-	105ns + 12UI	ns

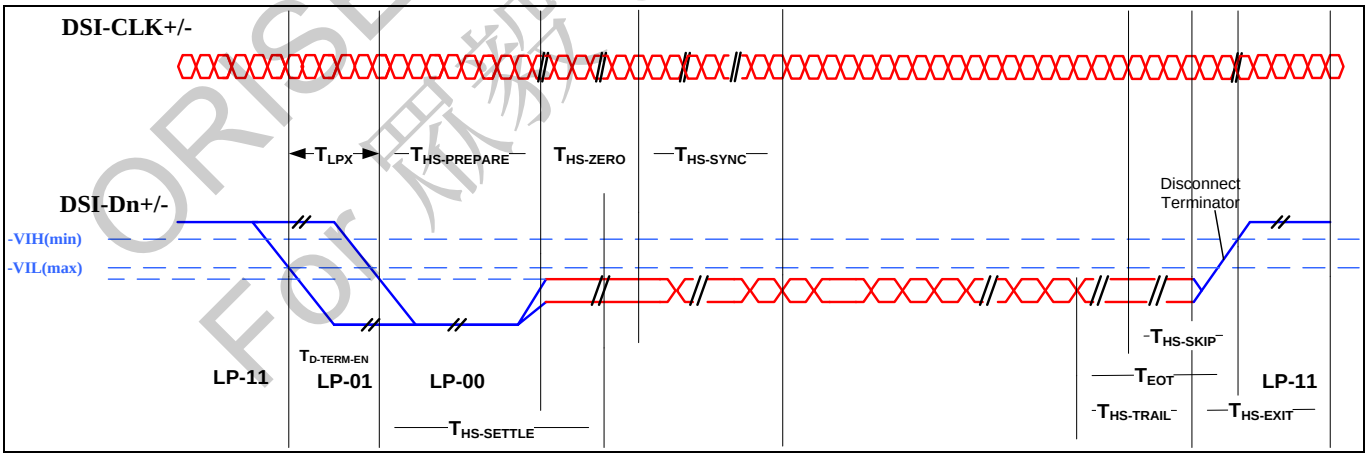

Fig. 7.3.1.3.1: High Speed Data Transmission Bursts

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Parameter	Symbol	Parameter	Specification			Unit
			MIN	TYP	MAX	
Switching the clock Lane between clock Transmission and Low Power Mode						
DSI-CLK+/-	$T_{CLK-POST}$	Time that the transmitter shall continue sending HS clock after the last associated Data Lane has transitioned to LP mode	60ns + 52UI	-	-	ns
DSI-CLK+/-	$T_{CLK-PRE}$	Time that the HS clock shall be driven prior to any associated Data Lane beginning the transition from LP to HS mode	8	-	-	UI
DSI-CLK+/-	$T_{CLK-PREPARE}$	Time to drive LP-00 to prepare for HS clock transmission	38	-	95	ns
DSI-CLK+/-	$T_{CLK-TERM-EN}$	Time to enable Clock Lane receiver line termination measured from when Dn crosses $V_{IL(max)}$	Time for Dn to reach $V_{TERM-EN}$	-	38	ns
DSI-CLK+/-	$T_{CLK-PREPARE}$ +$T_{CLK-ZERO}$	$T_{CLK-PREPARE}$ + time for lead HS-0 drive period before starting Clock	300	-	-	ns
DSI-CLK+/-	$T_{CLK-TRAIL}$	Time to drive HS differential state after last payload clock bit of a HS transmission burst	60	-	-	ns
DSI-CLK+/-	T_{EoT}	Time from start of $T_{CLK-TRAIL}$ period to start of LP-11 state	-	-	105ns + 12UI	ns

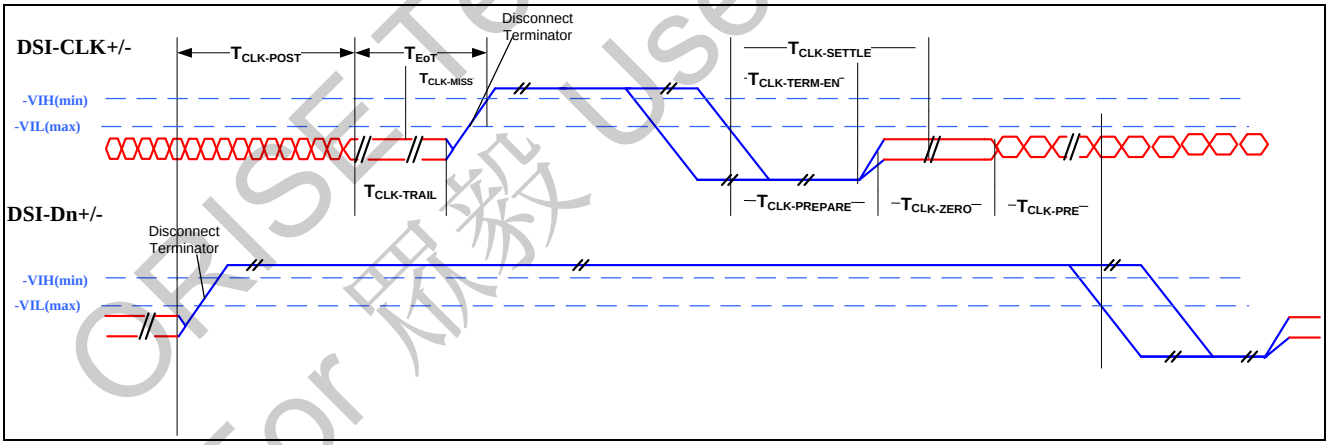

Fig. 7.3.1.3.2: Switching the clock Lane between clock Transmission and Low Power Mode

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7.3.1.4. LP-11 between high speed and low power modes

DSI-D0 High Speed or Low Power modes are starting or finishing from/to Stop State (SS, LP-11) when 4 different combinations, what are listed below, are possible:

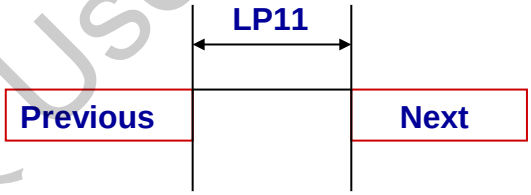
1. High Speed Mode => Stop State (SS, LP-11) => High Speed Mode
2. High Speed Mode => Stop State (SS, LP-11) => Low Power Mode
3. Low Power Mode => Stop State (SS, LP-11) => High Speed Mode
4. Low Power Mode => Stop State (SS, LP-11) => Low Power Mode

The Low Power Mode is also including 2 different functions:

1. Escape
2. Bus Turnaround (BTA)

Stop State (SS, LP-11) Timings from Previous mode to Next mode

Previous \ Next	Escape mode		HSDT		BTA	
	Min	Max	Min	Max	Min	Max
Escape mode	100 ns	-	100 ns	-	100 ns	-
HSDT	60ns + 52UI	-	60ns + 52UI	-	60ns + 52UI	-
BTA	100 ns	-	100 ns	-	100 ns	-



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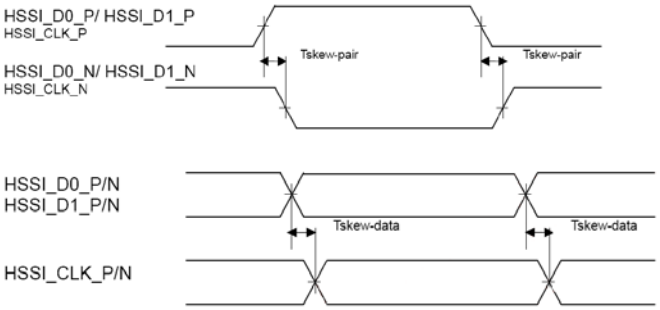
7.3.2. MDDI AC timing characteristics

Table 7.3.2.1: AC characteristics for MDDI

Parameter	Symbol	Conditions	Specification			Unit
			MIN	TYP	MAX	
Data Transfer Speed	1/tBIT	VCI=2.3V~5.5V VDDIO=1.65~3.6V TA=-30~+70℃	-	384	550	Mbps
Transfer input skew	|Tskew_Pair|		-	-	50	ps
Data _Stb input skew	|Tskew_Data|		-	-	300	ps



7.3.3. Allel Interface Characteristics 24/16/8-bits bus (8080-series MCU)

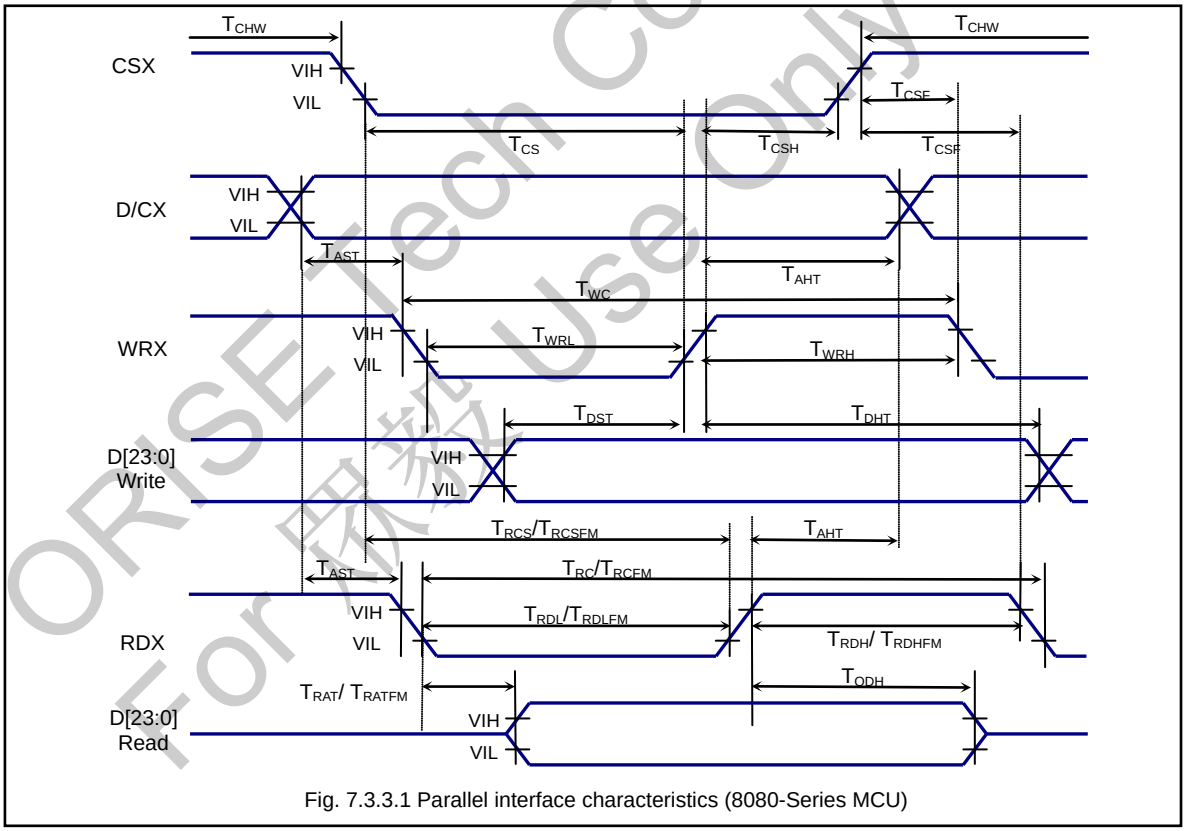


Fig. 7.3.3.1 Parallel interface characteristics (8080-Series MCU)

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Table 7.3.3.1: AC characteristics for parallel interface 24/18/16/8-bits bus (8080-series MCU)

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
D/CX	T_{AST}	Address setup time	0		ns	-
	T_{AHT}	Address hold time (Write/Read)	10		ns	
CSX	T_{CHW}	Chip select “H” pulse width	0		ns	-(3-transfer for one pixel) -(1-transfer for one pixel)
	T_{CS}	Chip select setup time (Write)	15		ns	
	T_{RCS}	Chip select setup time (Read ID)	45		ns	
	T_{RCSFM}	Chip select setup time (Read FM)	355		ns	
	T_{CSF}	Chip select wait time (Write/Read)	10		ns	
	T_{CSH}	Chip select hold time	10		ns	
WRX	T_{WC}	Write cycle	66		ns	
	T_{WRH}	Control pulse “H” duration	15		ns	
	T_{WRL}	Control pulse “L” duration	15		ns	
RDX (ID)	T_{RC}	Read cycle (ID)	160		ns	When read ID1~ID3 data
	T_{RDH}	Control pulse “H” duration (ID)	90		ns	
	T_{RDL}	Control pulse “L” duration (ID)	45		ns	
RDX (FM)	T_{RCFM}	Read cycle (FM = Frame Memory)	450		ns	When read from frame memory
	T_{RDHFM}	Control pulse “H” duration (FM)	90		ns	
	T_{RDLFM}	Control pulse “L” duration (FM)	355		ns	
D[23:0]	T_{DST}	Data setup time	10		ns	For maximum C_L=30pF For minimum C_L=8pF
	T_{DHT}	Data hold time	10		ns	
	T_{RAT}	Read access time (ID)		40	ns	
	T_{RATFM}	Read access time (FM)		340	ns	
	T_{ODH}	Output disable time	20	80	ns	

Note 1: VDDIO=1.65 to 3.6V, VCI=2.3 to 5.5V, VSSA=VSS=0V, Ta=-30 to 70℃

Note 2: The input signal rise time and fall time (Tr, Tf) is specified at 15 ns or less.
Logic high and low levels are specified as 30% and 70% of VDDIO for Input signals.

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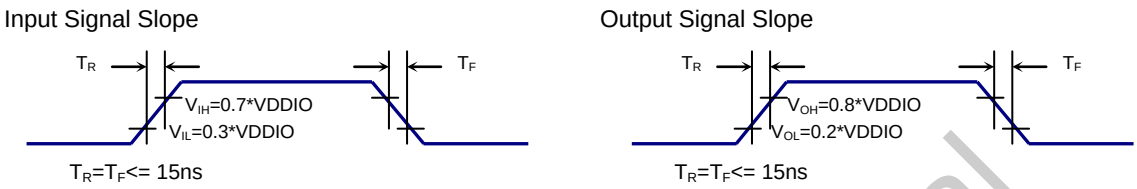

Fig. 7.3.3.2 Rising and Falling timing for Input and Output signal

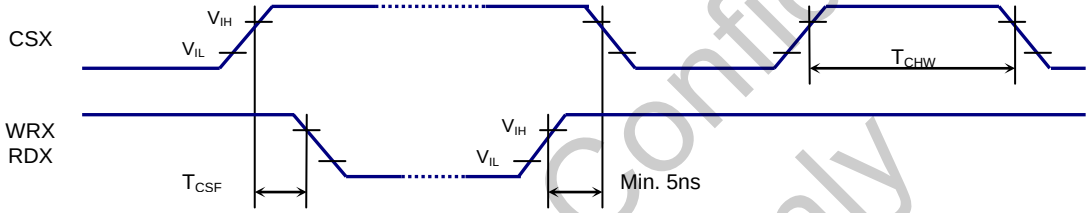

Fig. 7.3.3.3 Chip selection (CSX) timing

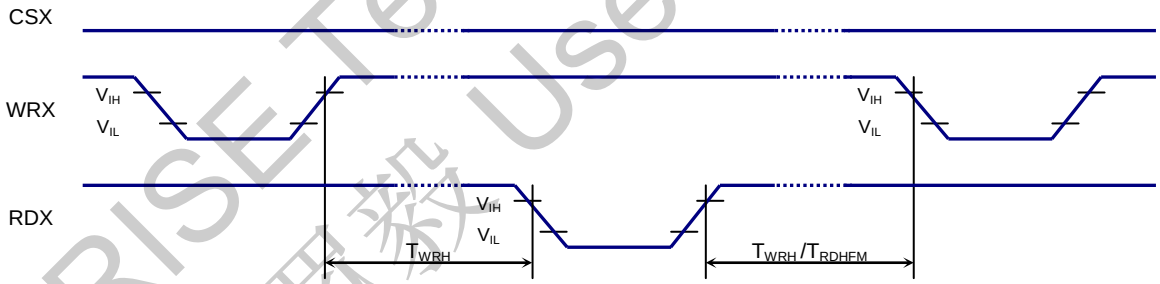

Fig. 7.3.3.4 Write to read and Read to write timing

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7.3.4. Serial interface characteristics (SPI)

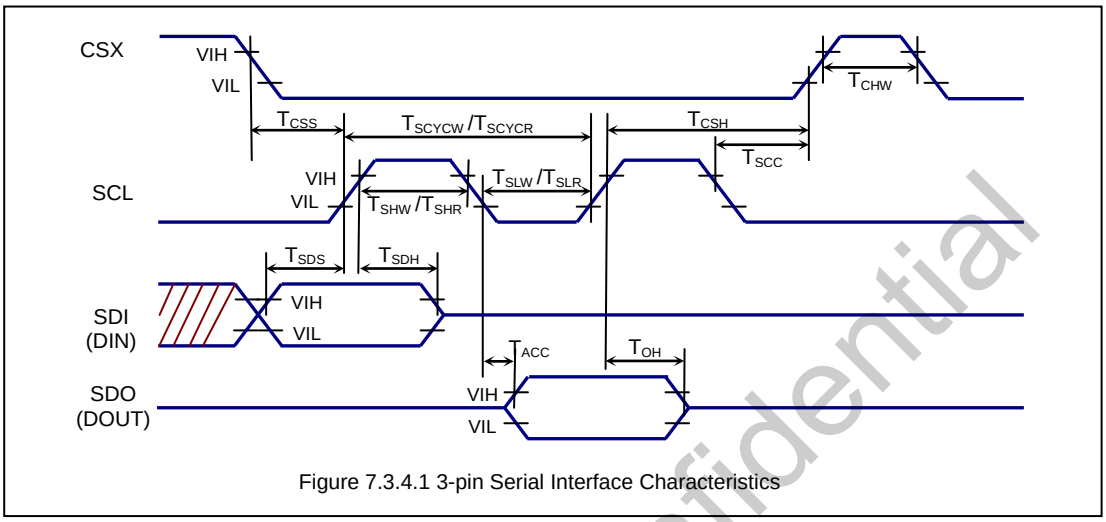

Figure 7.3.4.1 3-pin Serial Interface Characteristics

Table 7.3.4.1 SPI Interface Characteristics

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	T_{CSS}	Chip select setup time	15	-	ns	
	T_{CSH}	Chip select hold time	15	-	ns	
	T_{SCC}	Chip select setup time	20	-	ns	
	T_{CHW}	Chip select setup time	40	-	ns	
SCL	T_{SCYCW}	Serial clock cycle (Write)	66	-	ns	-
	T_{SHW}	SCL “H” pulse width (Write)	10	-	ns	
	T_{SLW}	SCL “L” pulse width (Write)	10	-	ns	
	T_{SCYCR}	Serial clock cycle (Read)	150	-	ns	
	T_{SHR}	SCL “H” pulse width (Read)	60	-	ns	
	T_{SLR}	SCL “L” pulse width (Read)	60	-	ns	
SDA (DIN) (DOUT)	T_{SDS}	Data setup time	10	-	ns	
	T_{SDH}	Data hold time	10	-	ns	
	T_{ACC}	Access time	10	50	ns	For maximum C_L=30pF
	T_{OH}	Output disable time	15	50	ns	For minimum C_L=8pF

Note 1: VDDIO=1.65 to 3.6V, VCI=2.3 to 5.5V, VSSA=VSS=0V, Ta=-30 to 70℃

Note 2: The input signal rise time and fall time (tr, tf) is specified at 15 ns or less.
Logic high and low levels are specified as 30% and 70% of VDDIO for Input signals.

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7.3.5. RGB interface characteristics

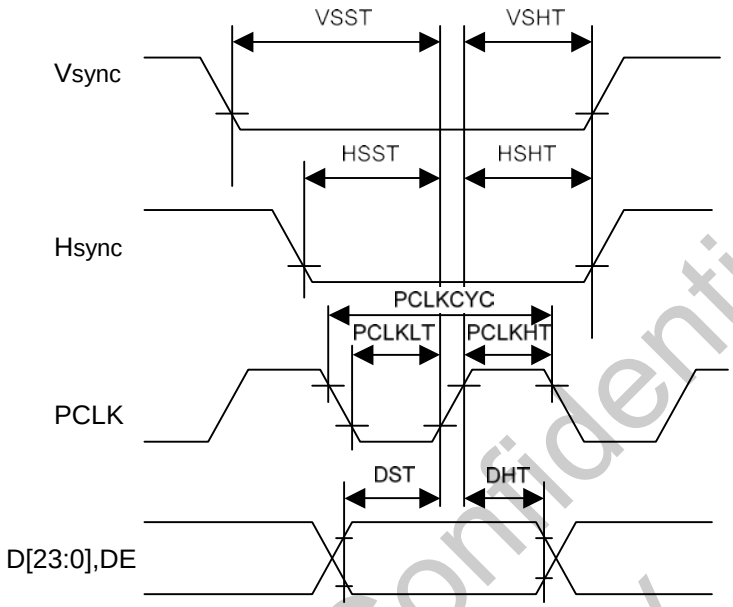

Figure 7.3.5.1 AC Timing Characteristics, RGB Interface

Table 7.3.5.1 RGB Interface Characteristics

(VCI=2.3V~5.5V, VDDIO = 1.65V~3.6V, Ta = -40℃ ~ 85℃)

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
Vsync	VSST	VS setup time	5	-	ns	
	VSHT	VS hold time	5	-	ns	
Hsync	HSST	HS setup time	5	-	ns	
	HSHT	HS hold time	5	-	ns	
PCLK		Pixel clock duty cycle	33	67	%	
	PCLKLT	Pixel clock low duration	14	-	ns	
	PCLKHT	Pixel clock high duration	14	-	ns	
D [23:0], DE	DST	Data setup time	5	-	ns	
	DHT	Date hold time	5	-	ns	

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7.3.6. I²C interface characteristics

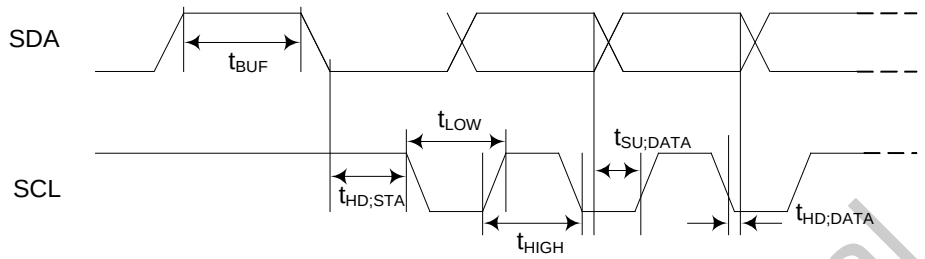

Table 7.3.6.1 I²C Interface Characteristics

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
f_{SCLK}	SCL clock frequency		DC	-	400	KHz
t_{LOW}	SCL clock LOW period		1.3	-	-	µs
t_{HIGH}	SCL clock HIGH period		0.6	-	-	µs
$t_{SU;DATA}$	data set-up time		100	-	-	ns
$t_{HD;DATA}$	data hold time		0	-	0.9	µs
t_R	SCL and SDA rise time	Note 2	$20+0.1C_b$	-	300	ns
t_F	SCL and SDA fall time	Note 2	$20+0.1C_b$	-	300	ns
t_F	SDA fall time for read out		$20+0.1C_b$	-	1000	ns
C_b	Capacitive load represented by each bus line		-	-	400	pF
$t_{SU;STA}$	Setup time for a repeated START condition		0.6	-	-	µs
$t_{HD;STA}$	START condition hold time		0.6	-	-	µs
$t_{SU;STO}$	Setup time for STOP condition		0.6	-	-	µs
t_{SW}	Tolerable spike width on bus	Note 1	-	-	50	ns
t_{BUF}	BUS free time between a STOP and START condition		1.3	-	-	µs

Note1: The device inputs SDA and SCL are filtered and will reject spikes on the bus lines of width $<t_{SW(max)}$.

Note2: The rise and fall times specified here refer to the driver device and are part of the general fast I²C-bus specification. C_b = capacitive load per bus line.

Note3: All timing values are valid within the operating supply voltage and ambient temperature ranges and are referenced to V_{IL} and V_{IH} with an input voltage swing of VSS to VDDIO.

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7.3.7. Reset timing characteristics

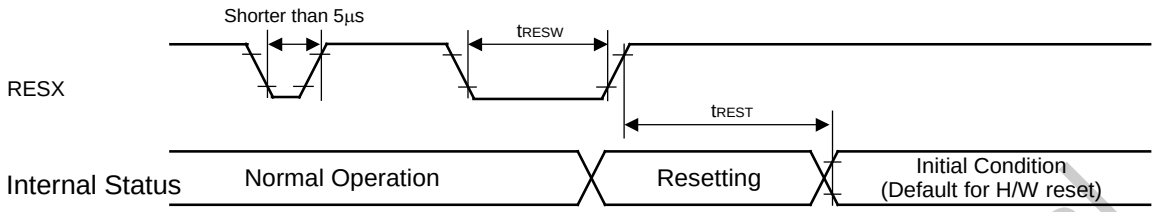


Table 7.3.7.1 Reset input timing

VSS=0V, VDDIO=1.6V to 3.6V, VCI=2.5V to 5.5V,Ta = -30 to 70°C

Symbol	Parameter	Related Pins	MIN	TYP	MAX	Note	Unit
t_{RESW}	*1) Reset low pulse width	RESX	10	-	-	-	µs
t_{REST}	*2) Reset complete time	-	-	-	5	When reset applied during Sleep in mode	ms
		-		-	120	When reset applied during Sleep out mode	ms

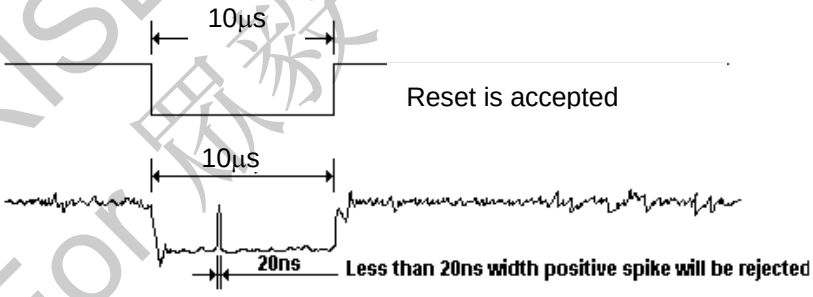
Note 1. Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below.

RESX Pulse	Action
Shorter than 5µs	Reset Rejected
Longer than 10µs	Reset
Between 5µs and 10µs	Reset starts (It depends on voltage and temperature condition.)

Note 2. During the resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120 ms, when Reset Starts in Sleep Out –mode. The display remains the blank state in Sleep In –mode) and then return to Default condition for H/W reset.

Note 3. During Reset Complete Time, ID1/ID2/ID3/ID4 and VCOM value in OTP will be latched to internal register during this period. This loading is done every time when there is H/W reset complete time (tREST) within 5ms after a rising edge of RESX.

Note 4. Spike Rejection also applies during a valid reset pulse as shown below:



Note 5. It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

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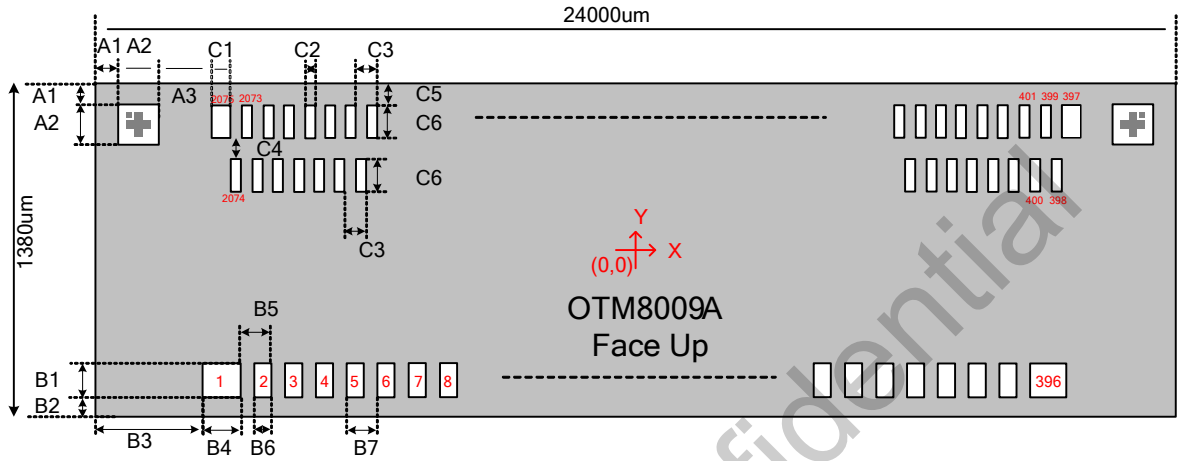
8. CHIP INFORMATION

8.1. PAD Assignment



Note1: Chip size included scribe line.

Note2: Have no temperature compensation design.

Note3: 15<A1<55, 15<B2<55, 30<B3<70, 15<C5<55

Symbol	Size	Symbol	Size
A1	55	B6	40
A2	150	B7	60
A3	14	C1	42
B1	120	C2	13
B2	55	C3	28
B3	70	C4	30
B4	100	C5	55
B5	60	C6	115

Unit: um

8.2. PAD Dimension

Item	PAD No.	Size		Unit
		X	Y	
Chip Size	-	24000	1380	um
Chip thickness	-	250 ± 10(OTM8009A-C) 250 ± 10(OTM8009A-C1) 200 ± 10(OTM8009A-C2) 200 ± 10(OTM8009A-C3) 200 ± 10(OTM8009A-C4) 250 ± 10(OTM8009A-C7)		
Pad pitch	2 ~ 395	60	--	
	398 ~ 2074	28	--	
Pad size	2 ~395	40	120	
	398 ~2074	13	115	
	1, 396	100	120	
	397, 2075	42	115	

Note1: Chip size included scribe line.

Note2: OTM8009A-C, OTM8009A-C2 , OTM8009A-C3 , OTM8009A-C4 with polish.

Note3: Xmin = X-80, Ymin = Y-80 , Xmax = X, Ymax = Y.

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8.3. Pad Location

NO.	PAD NAME	X-axis	Y-axis
1	VSS	-11880	-575
2	VSS	-11790	-575
3	PADA1	-11730	-575
4	PADB1	-11670	-575
5	VCOM	-11610	-575
6	VCOM	-11550	-575
7	VCOM	-11490	-575
8	VCOM	-11430	-575
9	VCOM	-11370	-575
10	CONTACT1A	-11310	-575
11	CONTACT1B	-11250	-575
12	MTP_PWR	-11190	-575
13	MTP_PWR	-11130	-575
14	MTP_PWR	-11070	-575
15	MTP_PWR	-11010	-575
16	MTP_PWR	-10950	-575
17	VGL	-10890	-575
18	VGL	-10830	-575
19	VGL	-10770	-575
20	VGL	-10710	-575
21	VGL_REG1	-10650	-575
22	VGL_REG1	-10590	-575
23	VRGH	-10530	-575
24	VRGH	-10470	-575
25	VCL	-10410	-575
26	VCL	-10350	-575
27	VCL	-10290	-575
28	VCL	-10230	-575
29	VREF_PWR	-10170	-575
30	VREF_PWR	-10110	-575
31	VREF_PWR	-10050	-575
32	VREF_PWR	-9990	-575
33	VSSA	-9930	-575
34	VSSA	-9870	-575
35	VSSA	-9810	-575
36	VSSA	-9750	-575
37	VDD	-9690	-575
38	VDD	-9630	-575
39	VDD	-9570	-575
40	VDD	-9510	-575
41	VDD	-9450	-575
42	VDD	-9390	-575
43	VDD	-9330	-575
44	VDD	-9270	-575
45	VSS	-9210	-575
46	VSS	-9150	-575
47	VSS	-9090	-575
48	VSS	-9030	-575
49	TEST0	-8970	-575
50	TEST1	-8910	-575
51	TEST2	-8850	-575
52	TEST3	-8790	-575
53	VDD	-8730	-575
54	DIOPWR	-8670	-575
55	DIOPWR	-8610	-575
56	VGSN	-8550	-575
57	VGSN	-8490	-575
58	VGSP	-8430	-575
59	VGMN	-8370	-575
60	VGMN	-8310	-575
61	VGMP	-8250	-575
62	VSS	-8190	-575
63	VSS	-8130	-575
64	VSS	-8070	-575
65	VDD_18V	-8010	-575
66	VDD_18V	-7950	-575
67	VDD_18V	-7890	-575
68	VDD	-7830	-575
69	VDD	-7770	-575
70	VDD	-7710	-575
71	VCL	-7650	-575
72	VCL	-7590	-575
73	VCL	-7530	-575
74	VCL	-7470	-575
75	VCL	-7410	-575
76	VCL	-7350	-575
77	VSSA	-7290	-575
78	VSSA	-7230	-575
79	VSSA	-7170	-575
80	VDDIO	-7110	-575
81	LANSEL	-7050	-575
82	DSWAP	-6990	-575
83	PSWAP	-6930	-575
84	VSS	-6870	-575
85	DSTB_SEL	-6810	-575
86	NBWSEL	-6750	-575
87	VGSW3	-6690	-575
88	VGSW2	-6630	-575
89	VGSW1	-6570	-575
90	VGSW0	-6510	-575
91	VDDIO	-6450	-575
92	I2C_SA1	-6390	-575
93	I2C_SA2	-6330	-575
94	IM3	-6270	-575
95	IM2	-6210	-575
96	IM1	-6150	-575
97	IM0	-6090	-575
98	GPO3	-6030	-575
99	GPO2	-5970	-575
100	GPO1	-5910	-575
101	GPO0	-5850	-575
102	EXB1T	-5790	-575
103	TE_L	-5730	-575
104	VSEL	-5670	-575
105	SDO	-5610	-575
106	SDI	-5550	-575
107	DCX	-5490	-575
108	WRX	-5430	-575
109	RDX	-5370	-575
110	CSX	-5310	-575
111	RESX	-5250	-575
112	VSS	-5190	-575
113	VSS	-5130	-575
114	VSS	-5070	-575
115	VDDIO	-5010	-575
116	VDDIO	-4950	-575
117	VDDIO	-4890	-575
118	D23	-4830	-575
119	D22	-4770	-575
120	D21	-4710	-575
121	D20	-4650	-575
122	D19	-4590	-575
123	D18	-4530	-575
124	D17	-4470	-575
125	D16	-4410	-575
126	D15	-4350	-575
127	D14	-4290	-575
128	D13	-4230	-575
129	D12	-4170	-575
130	D11	-4110	-575
131	D10	-4050	-575
132	D9	-3990	-575
133	D8	-3930	-575
134	D7	-3870	-575
135	D6	-3810	-575
136	D5	-3750	-575
137	D4	-3690	-575
138	D3	-3630	-575
139	D2	-3570	-575
140	D1	-3510	-575
141	D0	-3450	-575
142	DE	-3390	-575
143	PCLK	-3330	-575
144	HS	-3270	-575
145	VS	-3210	-575
146	LEDPWM	-3150	-575
147	LEDON	-3090	-575
148	KBBC	-3030	-575
149	ERR	-2970	-575
150	VDDIO	-2910	-575
151	VDDIO	-2850	-575
152	VDDIO	-2790	-575
153	VSS	-2730	-575
154	VSS	-2670	-575
155	VSS	-2610	-575
156	VDDA	-2550	-575
157	VDDA	-2490	-575
158	VDDA	-2430	-575
159	VDDA	-2370	-575
160	VSSA	-2310	-575
161	VSSA	-2250	-575
162	VSSA	-2190	-575
163	VSSA	-2130	-575
164	NVDDA	-2070	-575
165	NVDDA	-2010	-575

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NO.	PAD NAME	X-axis	Y-axis
166	NVDDA	-1950	-575
167	NVDDA	-1890	-575
168	NVDDA	-1830	-575
169	VCC	-1770	-575
170	VCC	-1710	-575
171	VCC	-1650	-575
172	VCC	-1590	-575
173	VSS	-1530	-575
174	VSS	-1470	-575
175	VSS	-1410	-575
176	VSS	-1350	-575
177	VDD_18V	-1290	-575
178	VDD_18V	-1230	-575
179	VDD_18V	-1170	-575
180	VDD_18V	-1110	-575
181	LVDSVSS	-1050	-575
182	LVDSVSS	-990	-575
183	LVDSVSS	-930	-575
184	LVDSVSS	-870	-575
185	LVDSVSS	-810	-575
186	D1_P	-750	-575
187	D1_P	-690	-575
188	D1_P	-630	-575
189	D1_P	-570	-575
190	D1_N	-510	-575
191	D1_N	-450	-575
192	D1_N	-390	-575
193	D1_N	-330	-575
194	LVDSVSS	-270	-575
195	LVDSVSS	-210	-575
196	CLK_P	-150	-575
197	CLK_P	-90	-575
198	CLK_P	-30	-575
199	CLK_P	30	-575
200	CLK_N	90	-575
201	CLK_N	150	-575
202	CLK_N	210	-575
203	CLK_N	270	-575
204	LVDSVSS	330	-575
205	LVDSVSS	390	-575
206	D0_P	450	-575
207	D0_P	510	-575
208	D0_P	570	-575
209	D0_P	630	-575
210	D0_N	690	-575
211	D0_N	750	-575
212	D0_N	810	-575
213	D0_N	870	-575
214	LVDSVSS	930	-575
215	LVDSVSS	990	-575
216	VDDP	1050	-575
217	VDDP	1110	-575
218	VDDP	1170	-575
219	LVDSVDD	1230	-575
220	LVDSVDD	1290	-575
221	LVDSVDD	1350	-575
222	VDDAM	1410	-575
223	VDDAM	1470	-575
224	VDDAM	1530	-575
225	VDDAM	1590	-575
226	VDDAM	1650	-575
227	VDD	1710	-575
228	VDD	1770	-575
229	VDD	1830	-575
230	OSC_TEST	1890	-575
231	TE_R	1950	-575
232	VSS	2010	-575
233	VSS	2070	-575
234	VSS	2130	-575
235	VSS	2190	-575
236	VREFCP	2250	-575
237	VREFCP	2310	-575
238	VRGH_DMY	2370	-575
239	VRGH_DMY	2430	-575
240	EXTP	2490	-575
241	EXTP	2550	-575
242	CSP	2610	-575
243	CSP	2670	-575
244	EXTN	2730	-575
245	EXTN	2790	-575
246	CSN	2850	-575
247	CSN	2910	-575
248	VDD	2970	-575
249	VDD	3030	-575
250	VDD	3090	-575
251	VDD	3150	-575
252	VDD	3210	-575
253	VDD	3270	-575
254	VSS	3330	-575
255	VSS	3390	-575
256	VSS	3450	-575
257	VSS	3510	-575
258	VSS	3570	-575
259	VSS	3630	-575
260	C11P	3690	-575
261	C11P	3750	-575
262	C11P	3810	-575
263	C11N	3870	-575
264	C11N	3930	-575
265	C11N	3990	-575
266	C12P	4050	-575
267	C12P	4110	-575
268	C12P	4170	-575
269	C12N	4230	-575
270	C12N	4290	-575
271	C12N	4350	-575
272	C13P	4410	-575
273	C13P	4470	-575
274	C13P	4530	-575
275	C13N	4590	-575
276	C13N	4650	-575
277	C13N	4710	-575
278	C14P	4770	-575
279	C14P	4830	-575
280	C14P	4890	-575
281	C14N	4950	-575
282	C14N	5010	-575
283	C14N	5070	-575
284	VDDA	5130	-575
285	VDDA	5190	-575
286	VDDA	5250	-575
287	VDDA	5310	-575
288	VSS	5370	-575
289	VSS	5430	-575
290	VSSA	5490	-575
291	VSSA	5550	-575
292	VSSA	5610	-575
293	NVDDA	5670	-575
294	NVDDA	5730	-575
295	NVDDA	5790	-575
296	NVDDA	5850	-575
297	NVDDA	5910	-575
298	NVDDA	5970	-575
299	C21P	6030	-575
300	C21P	6090	-575
301	C21P	6150	-575
302	C21N	6210	-575
303	C21N	6270	-575
304	C21N	6330	-575
305	C22P	6390	-575
306	C22P	6450	-575
307	C22P	6510	-575
308	C22N	6570	-575
309	C22N	6630	-575
310	C22N	6690	-575
311	C23P	6750	-575
312	C23P	6810	-575
313	C23P	6870	-575
314	C23N	6930	-575
315	C23N	6990	-575
316	C23N	7050	-575
317	C24P	7110	-575
318	C24P	7170	-575
319	C24P	7230	-575
320	C24N	7290	-575
321	C24N	7350	-575
322	C24N	7410	-575
323	VDD	7470	-575
324	VDD	7530	-575
325	VDD	7590	-575
326	VDD	7650	-575
327	VDD	7710	-575
328	VCL	7770	-575
329	VCL	7830	-575
330	VCL	7890	-575
331	VCL	7950	-575
332	VCL	8010	-575
333	VCL	8070	-575
334	VCL	8130	-575
335	VSSA	8190	-575
336	VSSA	8250	-575

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NO.	PAD NAME	X-axis	Y-axis
337	VSSA	8310	-575
338	VSS	8370	-575
339	VSS	8430	-575
340	VSS	8490	-575
341	VSS	8550	-575
342	C31P	8610	-575
343	C31P	8670	-575
344	C31P	8730	-575
345	C31N	8790	-575
346	C31N	8850	-575
347	C31N	8910	-575
348	C32P	8970	-575
349	C32P	9030	-575
350	C32P	9090	-575
351	C32N	9150	-575
352	C32N	9210	-575
353	C32N	9270	-575
354	VDD_18V	9330	-575
355	VDD_18V	9390	-575
356	VDD_18V	9450	-575
357	VSS	9510	-575
358	VSS	9570	-575
359	VSS	9630	-575
360	C41P	9690	-575
361	C41P	9750	-575
362	C41N	9810	-575
363	C41N	9870	-575
364	VGH	9930	-575
365	VGH	9990	-575
366	VGHO_R	10050	-575
367	VGHO_R	10110	-575
368	VRGH	10170	-575
369	VRGH	10230	-575
370	C51P	10290	-575
371	C51P	10350	-575
372	C51N	10410	-575
373	C51N	10470	-575
374	VGL_REG	10530	-575
375	VGL_REG	10590	-575
376	VGL	10650	-575
377	VGL	10710	-575
378	VGL	10770	-575
379	VGL	10830	-575
380	VGL	10890	-575
381	VGL	10950	-575
382	TEST4	11010	-575
383	TEST5	11070	-575
384	TEST6	11130	-575
385	TEST7	11190	-575
386	CONTACT2A	11250	-575
387	CONTACT2B	11310	-575
388	VCOM	11370	-575
389	VCOM	11430	-575
390	VCOM	11490	-575
391	VCOM	11550	-575
392	VCOM	11610	-575
393	PADA2	11670	-575
394	PADB2	11730	-575
395	VSS	11790	-575
396	VSS	11880	-575
397	VSS	11760	577.5
398	VSS	11732	432.5
399	VSS	11718	577.5
400	PADA3	11704	432.5
401	PADB3	11690	577.5
402	VGHO_R	11676	432.5
403	VGHO_R	11662	577.5
404	VGHO_R	11648	432.5
405	VGL	11634	577.5
406	VGL	11620	432.5
407	VGL	11606	577.5
408	GOUT1	11592	432.5
409	GOUT1	11578	577.5
410	GOUT2	11564	432.5
411	GOUT2	11550	577.5
412	LVGL2	11536	432.5
413	LVGL2	11522	577.5
414	LVGL2	11508	432.5
415	VRGH	11494	577.5
416	VRGH	11480	432.5
417	VRGH	11466	577.5
418	VGL	11452	432.5
419	VGL	11438	577.5
420	VGL	11424	432.5
421	GOUT3	11410	577.5
422	GOUT3	11396	432.5
423	GOUT4	11382	577.5
424	GOUT4	11368	432.5
425	GOUT5	11354	577.5
426	GOUT5	11340	432.5
427	GOUT6	11326	577.5
428	GOUT6	11312	432.5
429	GOUT7	11298	577.5
430	GOUT7	11284	432.5
431	GOUT8	11270	577.5
432	GOUT8	11256	432.5
433	GOUT9	11242	577.5
434	GOUT9	11228	432.5
435	GOUT10	11214	577.5
436	GOUT10	11200	432.5
437	GOUT11	11186	577.5
438	GOUT11	11172	432.5
439	GOUT12	11158	577.5
440	GOUT12	11144	432.5
441	GOUT13	11130	577.5
442	GOUT13	11116	432.5
443	GOUT14	11102	577.5
444	GOUT14	11088	432.5
445	GOUT15	11074	577.5
446	GOUT15	11060	432.5
447	GOUT16	11046	577.5
448	GOUT16	11032	432.5
449	VGHO_R	11018	577.5
450	VGHO_R	11004	432.5
451	VGHO_R	10990	577.5
452	VGHO_R	10976	432.5
453	VGHO_R	10962	577.5
454	VGHO_R	10948	432.5
455	VGHO_R	10934	577.5
456	VGHO_R	10920	432.5
457	VGL	10906	577.5
458	VGL	10892	432.5
459	VGL	10878	577.5
460	VGL	10864	432.5
461	VGL	10850	577.5
462	VGL	10836	432.5
463	VGL	10822	577.5
464	VGL	10808	432.5
465	VGL	10794	577.5
466	VSS	10780	432.5
467	VSS	10766	577.5
468	SDUM0	10752	432.5
469	SDUM1	10738	577.5
470	S1	10724	432.5
471	S2	10710	577.5
472	S3	10696	432.5
473	S4	10682	577.5
474	S5	10668	432.5
475	S6	10654	577.5
476	S7	10640	432.5
477	S8	10626	577.5
478	S9	10612	432.5
479	S10	10598	577.5
480	S11	10584	432.5
481	S12	10570	577.5
482	S13	10556	432.5
483	S14	10542	577.5
484	S15	10528	432.5
485	S16	10514	577.5
486	S17	10500	432.5
487	S18	10486	577.5
488	S19	10472	432.5
489	S20	10458	577.5
490	S21	10444	432.5
491	S22	10430	577.5
492	S23	10416	432.5
493	S24	10402	577.5
494	S25	10388	432.5
495	S26	10374	577.5
496	S27	10360	432.5
497	S28	10346	577.5
498	S29	10332	432.5
499	S30	10318	577.5
500	S31	10304	432.5
501	S32	10290	577.5
502	S33	10276	432.5
503	S34	10262	577.5
504	S35	10248	432.5
505	S36	10234	577.5
506	S37	10220	432.5
507	S38	10206	577.5

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NO.	PAD NAME	X-axis	Y-axis
508	S39	10192	432.5
509	S40	10178	577.5
510	S41	10164	432.5
511	S42	10150	577.5
512	S43	10136	432.5
513	S44	10122	577.5
514	S45	10108	432.5
515	S46	10094	577.5
516	S47	10080	432.5
517	S48	10066	577.5
518	S49	10052	432.5
519	S50	10038	577.5
520	S51	10024	432.5
521	S52	10010	577.5
522	S53	9996	432.5
523	S54	9982	577.5
524	S55	9968	432.5
525	S56	9954	577.5
526	S57	9940	432.5
527	S58	9926	577.5
528	S59	9912	432.5
529	S60	9898	577.5
530	S61	9884	432.5
531	S62	9870	577.5
532	S63	9856	432.5
533	S64	9842	577.5
534	S65	9828	432.5
535	S66	9814	577.5
536	S67	9800	432.5
537	S68	9786	577.5
538	S69	9772	432.5
539	S70	9758	577.5
540	S71	9744	432.5
541	S72	9730	577.5
542	S73	9716	432.5
543	S74	9702	577.5
544	S75	9688	432.5
545	S76	9674	577.5
546	S77	9660	432.5
547	S78	9646	577.5
548	S79	9632	432.5
549	S80	9618	577.5
550	S81	9604	432.5
551	S82	9590	577.5
552	S83	9576	432.5
553	S84	9562	577.5
554	S85	9548	432.5
555	S86	9534	577.5
556	S87	9520	432.5
557	S88	9506	577.5
558	S89	9492	432.5
559	S90	9478	577.5
560	S91	9464	432.5
561	S92	9450	577.5
562	S93	9436	432.5
563	S94	9422	577.5
564	S95	9408	432.5

NO.	PAD NAME	X-axis	Y-axis
565	S96	9394	577.5
566	S97	9380	432.5
567	S98	9366	577.5
568	S99	9352	432.5
569	S100	9338	577.5
570	S101	9324	432.5
571	S102	9310	577.5
572	S103	9296	432.5
573	S104	9282	577.5
574	S105	9268	432.5
575	S106	9254	577.5
576	S107	9240	432.5
577	S108	9226	577.5
578	S109	9212	432.5
579	S110	9198	577.5
580	S111	9184	432.5
581	S112	9170	577.5
582	S113	9156	432.5
583	S114	9142	577.5
584	S115	9128	432.5
585	S116	9114	577.5
586	S117	9100	432.5
587	S118	9086	577.5
588	S119	9072	432.5
589	S120	9058	577.5
590	S121	9044	432.5
591	S122	9030	577.5
592	S123	9016	432.5
593	S124	9002	577.5
594	S125	8988	432.5
595	S126	8974	577.5
596	S127	8960	432.5
597	S128	8946	577.5
598	S129	8932	432.5
599	S130	8918	577.5
600	S131	8904	432.5
601	S132	8890	577.5
602	S133	8876	432.5
603	S134	8862	577.5
604	S135	8848	432.5
605	S136	8834	577.5
606	S137	8820	432.5
607	S138	8806	577.5
608	S139	8792	432.5
609	S140	8778	577.5
610	S141	8764	432.5
611	S142	8750	577.5
612	S143	8736	432.5
613	S144	8722	577.5
614	S145	8708	432.5
615	S146	8694	577.5
616	S147	8680	432.5
617	S148	8666	577.5
618	S149	8652	432.5
619	S150	8638	577.5
620	S151	8624	432.5
621	S152	8610	577.5

NO.	PAD NAME	X-axis	Y-axis
622	S153	8596	432.5
623	S154	8582	577.5
624	S155	8568	432.5
625	S156	8554	577.5
626	S157	8540	432.5
627	S158	8526	577.5
628	S159	8512	432.5
629	S160	8498	577.5
630	S161	8484	432.5
631	S162	8470	577.5
632	S163	8456	432.5
633	S164	8442	577.5
634	S165	8428	432.5
635	S166	8414	577.5
636	S167	8400	432.5
637	S168	8386	577.5
638	S169	8372	432.5
639	S170	8358	577.5
640	S171	8344	432.5
641	S172	8330	577.5
642	S173	8316	432.5
643	S174	8302	577.5
644	S175	8288	432.5
645	S176	8274	577.5
646	S177	8260	432.5
647	S178	8246	577.5
648	S179	8232	432.5
649	S180	8218	577.5
650	S181	8204	432.5
651	S182	8190	577.5
652	S183	8176	432.5
653	S184	8162	577.5
654	S185	8148	432.5
655	S186	8134	577.5
656	S187	8120	432.5
657	S188	8106	577.5
658	S189	8092	432.5
659	S190	8078	577.5
660	S191	8064	432.5
661	S192	8050	577.5
662	S193	8036	432.5
663	S194	8022	577.5
664	S195	8008	432.5
665	S196	7994	577.5
666	S197	7980	432.5
667	S198	7966	577.5
668	S199	7952	432.5
669	S200	7938	577.5
670	S201	7924	432.5
671	S202	7910	577.5
672	S203	7896	432.5
673	S204	7882	577.5
674	S205	7868	432.5
675	S206	7854	577.5
676	S207	7840	432.5
677	S208	7826	577.5
678	S209	7812	432.5

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NO.	PAD NAME	X-axis	Y-axis
679	S210	7798	577.5
680	S211	7784	432.5
681	S212	7770	577.5
682	S213	7756	432.5
683	S214	7742	577.5
684	S215	7728	432.5
685	S216	7714	577.5
686	S217	7700	432.5
687	S218	7686	577.5
688	S219	7672	432.5
689	S220	7658	577.5
690	S221	7644	432.5
691	S222	7630	577.5
692	S223	7616	432.5
693	S224	7602	577.5
694	S225	7588	432.5
695	S226	7574	577.5
696	S227	7560	432.5
697	S228	7546	577.5
698	S229	7532	432.5
699	S230	7518	577.5
700	S231	7504	432.5
701	S232	7490	577.5
702	S233	7476	432.5
703	S234	7462	577.5
704	S235	7448	432.5
705	S236	7434	577.5
706	S237	7420	432.5
707	S238	7406	577.5
708	S239	7392	432.5
709	S240	7378	577.5
710	S241	7364	432.5
711	S242	7350	577.5
712	S243	7336	432.5
713	S244	7322	577.5
714	S245	7308	432.5
715	S246	7294	577.5
716	S247	7280	432.5
717	S248	7266	577.5
718	S249	7252	432.5
719	S250	7238	577.5
720	S251	7224	432.5
721	S252	7210	577.5
722	S253	7196	432.5
723	S254	7182	577.5
724	S255	7168	432.5
725	S256	7154	577.5
726	S257	7140	432.5
727	S258	7126	577.5
728	S259	7112	432.5
729	S260	7098	577.5
730	S261	7084	432.5
731	S262	7070	577.5
732	S263	7056	432.5
733	S264	7042	577.5
734	S265	7028	432.5
735	S266	7014	577.5

NO.	PAD NAME	X-axis	Y-axis
736	S267	7000	432.5
737	S268	6986	577.5
738	S269	6972	432.5
739	S270	6958	577.5
740	S271	6944	432.5
741	S272	6930	577.5
742	S273	6916	432.5
743	S274	6902	577.5
744	S275	6888	432.5
745	S276	6874	577.5
746	S277	6860	432.5
747	S278	6846	577.5
748	S279	6832	432.5
749	S280	6818	577.5
750	S281	6804	432.5
751	S282	6790	577.5
752	S283	6776	432.5
753	S284	6762	577.5
754	S285	6748	432.5
755	S286	6734	577.5
756	S287	6720	432.5
757	S288	6706	577.5
758	S289	6692	432.5
759	S290	6678	577.5
760	S291	6664	432.5
761	S292	6650	577.5
762	S293	6636	432.5
763	S294	6622	577.5
764	S295	6608	432.5
765	S296	6594	577.5
766	S297	6580	432.5
767	S298	6566	577.5
768	S299	6552	432.5
769	S300	6538	577.5
770	S301	6524	432.5
771	S302	6510	577.5
772	S303	6496	432.5
773	S304	6482	577.5
774	S305	6468	432.5
775	S306	6454	577.5
776	S307	6440	432.5
777	S308	6426	577.5
778	S309	6412	432.5
779	S310	6398	577.5
780	S311	6384	432.5
781	S312	6370	577.5
782	S313	6356	432.5
783	S314	6342	577.5
784	S315	6328	432.5
785	S316	6314	577.5
786	S317	6300	432.5
787	S318	6286	577.5
788	S319	6272	432.5
789	S320	6258	577.5
790	S321	6244	432.5
791	S322	6230	577.5
792	S323	6216	432.5

NO.	PAD NAME	X-axis	Y-axis
793	S324	6202	577.5
794	S325	6188	432.5
795	S326	6174	577.5
796	S327	6160	432.5
797	S328	6146	577.5
798	S329	6132	432.5
799	S330	6118	577.5
800	S331	6104	432.5
801	S332	6090	577.5
802	S333	6076	432.5
803	S334	6062	577.5
804	S335	6048	432.5
805	S336	6034	577.5
806	S337	6020	432.5
807	S338	6006	577.5
808	S339	5992	432.5
809	S340	5978	577.5
810	S341	5964	432.5
811	S342	5950	577.5
812	S343	5936	432.5
813	S344	5922	577.5
814	S345	5908	432.5
815	S346	5894	577.5
816	S347	5880	432.5
817	S348	5866	577.5
818	S349	5852	432.5
819	S350	5838	577.5
820	S351	5824	432.5
821	S352	5810	577.5
822	S353	5796	432.5
823	S354	5782	577.5
824	S355	5768	432.5
825	S356	5754	577.5
826	S357	5740	432.5
827	S358	5726	577.5
828	S359	5712	432.5
829	S360	5698	577.5
830	S361	5684	432.5
831	S362	5670	577.5
832	S363	5656	432.5
833	S364	5642	577.5
834	S365	5628	432.5
835	S366	5614	577.5
836	S367	5600	432.5
837	S368	5586	577.5
838	S369	5572	432.5
839	S370	5558	577.5
840	S371	5544	432.5
841	S372	5530	577.5
842	S373	5516	432.5
843	S374	5502	577.5
844	S375	5488	432.5
845	S376	5474	577.5
846	S377	5460	432.5
847	S378	5446	577.5
848	S379	5432	432.5
849	S380	5418	577.5

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NO.	PAD NAME	X-axis	Y-axis
850	S381	5404	432.5
851	S382	5390	577.5
852	S383	5376	432.5
853	S384	5362	577.5
854	S385	5348	432.5
855	S386	5334	577.5
856	S387	5320	432.5
857	S388	5306	577.5
858	S389	5292	432.5
859	S390	5278	577.5
860	S391	5264	432.5
861	S392	5250	577.5
862	S393	5236	432.5
863	S394	5222	577.5
864	S395	5208	432.5
865	S396	5194	577.5
866	S397	5180	432.5
867	S398	5166	577.5
868	S399	5152	432.5
869	S400	5138	577.5
870	S401	5124	432.5
871	S402	5110	577.5
872	S403	5096	432.5
873	S404	5082	577.5
874	S405	5068	432.5
875	S406	5054	577.5
876	S407	5040	432.5
877	S408	5026	577.5
878	S409	5012	432.5
879	S410	4998	577.5
880	S411	4984	432.5
881	S412	4970	577.5
882	S413	4956	432.5
883	S414	4942	577.5
884	S415	4928	432.5
885	S416	4914	577.5
886	S417	4900	432.5
887	S418	4886	577.5
888	S419	4872	432.5
889	S420	4858	577.5
890	S421	4844	432.5
891	S422	4830	577.5
892	S423	4816	432.5
893	S424	4802	577.5
894	S425	4788	432.5
895	S426	4774	577.5
896	S427	4760	432.5
897	S428	4746	577.5
898	S429	4732	432.5
899	S430	4718	577.5
900	S431	4704	432.5
901	S432	4690	577.5
902	S433	4676	432.5
903	S434	4662	577.5
904	S435	4648	432.5
905	S436	4634	577.5
906	S437	4620	432.5

NO.	PAD NAME	X-axis	Y-axis
907	S438	4606	577.5
908	S439	4592	432.5
909	S440	4578	577.5
910	S441	4564	432.5
911	S442	4550	577.5
912	S443	4536	432.5
913	S444	4522	577.5
914	S445	4508	432.5
915	S446	4494	577.5
916	S447	4480	432.5
917	S448	4466	577.5
918	S449	4452	432.5
919	S450	4438	577.5
920	S451	4424	432.5
921	S452	4410	577.5
922	S453	4396	432.5
923	S454	4382	577.5
924	S455	4368	432.5
925	S456	4354	577.5
926	S457	4340	432.5
927	S458	4326	577.5
928	S459	4312	432.5
929	S460	4298	577.5
930	S461	4284	432.5
931	S462	4270	577.5
932	S463	4256	432.5
933	S464	4242	577.5
934	S465	4228	432.5
935	S466	4214	577.5
936	S467	4200	432.5
937	S468	4186	577.5
938	S469	4172	432.5
939	S470	4158	577.5
940	S471	4144	432.5
941	S472	4130	577.5
942	S473	4116	432.5
943	S474	4102	577.5
944	S475	4088	432.5
945	S476	4074	577.5
946	S477	4060	432.5
947	S478	4046	577.5
948	S479	4032	432.5
949	S480	4018	577.5
950	S481	4004	432.5
951	S482	3990	577.5
952	S483	3976	432.5
953	S484	3962	577.5
954	S485	3948	432.5
955	S486	3934	577.5
956	S487	3920	432.5
957	S488	3906	577.5
958	S489	3892	432.5
959	S490	3878	577.5
960	S491	3864	432.5
961	S492	3850	577.5
962	S493	3836	432.5
963	S494	3822	577.5

NO.	PAD NAME	X-axis	Y-axis
964	S495	3808	432.5
965	S496	3794	577.5
966	S497	3780	432.5
967	S498	3766	577.5
968	S499	3752	432.5
969	S500	3738	577.5
970	S501	3724	432.5
971	S502	3710	577.5
972	S503	3696	432.5
973	S504	3682	577.5
974	S505	3668	432.5
975	S506	3654	577.5
976	S507	3640	432.5
977	S508	3626	577.5
978	S509	3612	432.5
979	S510	3598	577.5
980	S511	3584	432.5
981	S512	3570	577.5
982	S513	3556	432.5
983	S514	3542	577.5
984	S515	3528	432.5
985	S516	3514	577.5
986	S517	3500	432.5
987	S518	3486	577.5
988	S519	3472	432.5
989	S520	3458	577.5
990	S521	3444	432.5
991	S522	3430	577.5
992	S523	3416	432.5
993	S524	3402	577.5
994	S525	3388	432.5
995	S526	3374	577.5
996	S527	3360	432.5
997	S528	3346	577.5
998	S529	3332	432.5
999	S530	3318	577.5
1000	S531	3304	432.5
1001	S532	3290	577.5
1002	S533	3276	432.5
1003	S534	3262	577.5
1004	S535	3248	432.5
1005	S536	3234	577.5
1006	S537	3220	432.5
1007	S538	3206	577.5
1008	S539	3192	432.5
1009	S540	3178	577.5
1010	S541	3164	432.5
1011	S542	3150	577.5
1012	S543	3136	432.5
1013	S544	3122	577.5
1014	S545	3108	432.5
1015	S546	3094	577.5
1016	S547	3080	432.5
1017	S548	3066	577.5
1018	S549	3052	432.5
1019	S550	3038	577.5
1020	S551	3024	432.5

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NO.	PAD NAME	X-axis	Y-axis
1021	S552	3010	577.5
1022	S553	2996	432.5
1023	S554	2982	577.5
1024	S555	2968	432.5
1025	S556	2954	577.5
1026	S557	2940	432.5
1027	S558	2926	577.5
1028	S559	2912	432.5
1029	S560	2898	577.5
1030	S561	2884	432.5
1031	S562	2870	577.5
1032	S563	2856	432.5
1033	S564	2842	577.5
1034	S565	2828	432.5
1035	S566	2814	577.5
1036	S567	2800	432.5
1037	S568	2786	577.5
1038	S569	2772	432.5
1039	S570	2758	577.5
1040	S571	2744	432.5
1041	S572	2730	577.5
1042	S573	2716	432.5
1043	S574	2702	577.5
1044	S575	2688	432.5
1045	S576	2674	577.5
1046	S577	2660	432.5
1047	S578	2646	577.5
1048	S579	2632	432.5
1049	S580	2618	577.5
1050	S581	2604	432.5
1051	S582	2590	577.5
1052	S583	2576	432.5
1053	S584	2562	577.5
1054	S585	2548	432.5
1055	S586	2534	577.5
1056	S587	2520	432.5
1057	S588	2506	577.5
1058	S589	2492	432.5
1059	S590	2478	577.5
1060	S591	2464	432.5
1061	S592	2450	577.5
1062	S593	2436	432.5
1063	S594	2422	577.5
1064	S595	2408	432.5
1065	S596	2394	577.5
1066	S597	2380	432.5
1067	S598	2366	577.5
1068	S599	2352	432.5
1069	S600	2338	577.5
1070	S601	2324	432.5
1071	S602	2310	577.5
1072	S603	2296	432.5
1073	S604	2282	577.5
1074	S605	2268	432.5
1075	S606	2254	577.5
1076	S607	2240	432.5
1077	S608	2226	577.5
1078	S609	2212	432.5
1079	S610	2198	577.5
1080	S611	2184	432.5
1081	S612	2170	577.5
1082	S613	2156	432.5
1083	S614	2142	577.5
1084	S615	2128	432.5
1085	S616	2114	577.5
1086	S617	2100	432.5
1087	S618	2086	577.5
1088	S619	2072	432.5
1089	S620	2058	577.5
1090	S621	2044	432.5
1091	S622	2030	577.5
1092	S623	2016	432.5
1093	S624	2002	577.5
1094	S625	1988	432.5
1095	S626	1974	577.5
1096	S627	1960	432.5
1097	S628	1946	577.5
1098	S629	1932	432.5
1099	S630	1918	577.5
1100	S631	1904	432.5
1101	S632	1890	577.5
1102	S633	1876	432.5
1103	S634	1862	577.5
1104	S635	1848	432.5
1105	S636	1834	577.5
1106	S637	1820	432.5
1107	S638	1806	577.5
1108	S639	1792	432.5
1109	S640	1778	577.5
1110	S641	1764	432.5
1111	S642	1750	577.5
1112	S643	1736	432.5
1113	S644	1722	577.5
1114	S645	1708	432.5
1115	S646	1694	577.5
1116	S647	1680	432.5
1117	S648	1666	577.5
1118	S649	1652	432.5
1119	S650	1638	577.5
1120	S651	1624	432.5
1121	S652	1610	577.5
1122	S653	1596	432.5
1123	S654	1582	577.5
1124	S655	1568	432.5
1125	S656	1554	577.5
1126	S657	1540	432.5
1127	S658	1526	577.5
1128	S659	1512	432.5
1129	S660	1498	577.5
1130	S661	1484	432.5
1131	S662	1470	577.5
1132	S663	1456	432.5
1133	S664	1442	577.5
1134	S665	1428	432.5
1135	S666	1414	577.5
1136	S667	1400	432.5
1137	S668	1386	577.5
1138	S669	1372	432.5
1139	S670	1358	577.5
1140	S671	1344	432.5
1141	S672	1330	577.5
1142	S673	1316	432.5
1143	S674	1302	577.5
1144	S675	1288	432.5
1145	S676	1274	577.5
1146	S677	1260	432.5
1147	S678	1246	577.5
1148	S679	1232	432.5
1149	S680	1218	577.5
1150	S681	1204	432.5
1151	S682	1190	577.5
1152	S683	1176	432.5
1153	S684	1162	577.5
1154	S685	1148	432.5
1155	S686	1134	577.5
1156	S687	1120	432.5
1157	S688	1106	577.5
1158	S689	1092	432.5
1159	S690	1078	577.5
1160	S691	1064	432.5
1161	S692	1050	577.5
1162	S693	1036	432.5
1163	S694	1022	577.5
1164	S695	1008	432.5
1165	S696	994	577.5
1166	S697	980	432.5
1167	S698	966	577.5
1168	S699	952	432.5
1169	S700	938	577.5
1170	S701	924	432.5
1171	S702	910	577.5
1172	S703	896	432.5
1173	S704	882	577.5
1174	S705	868	432.5
1175	S706	854	577.5
1176	S707	840	432.5
1177	S708	826	577.5
1178	S709	812	432.5
1179	S710	798	577.5
1180	S711	784	432.5
1181	S712	770	577.5
1182	S713	756	432.5
1183	S714	742	577.5
1184	S715	728	432.5
1185	S716	714	577.5
1186	S717	700	432.5
1187	S718	686	577.5
1188	S719	672	432.5
1189	S720	658	577.5
1190	VSSIDUM2	644	432.5
1191	VSSIDUM2	630	577.5

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NO.	PAD NAME	X-axis	Y-axis
1192	VSSIDUM2	616	432.5
1193	VSSIDUM2	602	577.5
1194	VSSIDUM2	588	432.5
1195	VSSIDUM2	574	577.5
1196	VSSIDUM2	560	432.5
1197	VSSIDUM2	546	577.5
1198	VSSIDUM2	532	432.5
1199	VSSIDUM2	518	577.5
1200	VSSIDUM2	504	432.5
1201	VSSIDUM2	490	577.5
1202	VSSIDUM2	476	432.5
1203	VSSIDUM2	462	577.5
1204	VSSIDUM2	448	432.5
1205	VSSIDUM2	434	577.5
1206	VSSIDUM2	420	432.5
1207	VSSIDUM2	406	577.5
1208	VSSIDUM2	392	432.5
1209	VSSIDUM2	378	577.5
1210	VSSIDUM2	364	432.5
1211	VSSIDUM2	350	577.5
1212	VSSIDUM2	336	432.5
1213	VSSIDUM2	322	577.5
1214	VSSIDUM2	308	432.5
1215	VSSIDUM2	294	577.5
1216	VSSIDUM2	280	432.5
1217	VSSIDUM2	266	577.5
1218	VSSIDUM2	252	432.5
1219	VSSIDUM2	238	577.5
1220	VSSIDUM2	224	432.5
1221	VSSIDUM2	210	577.5
1222	VSSIDUM2	196	432.5
1223	VSSIDUM2	182	577.5
1224	VSSIDUM2	168	432.5
1225	VSSIDUM2	154	577.5
1226	VSSIDUM2	140	432.5
1227	VSSIDUM2	126	577.5
1228	VSSIDUM2	112	432.5
1229	VSSIDUM2	98	577.5
1230	VSSIDUM2	84	432.5
1231	VSSIDUM2	70	577.5
1232	VSSIDUM2	56	432.5
1233	VSSIDUM2	42	577.5
1234	VSSIDUM2	28	432.5
1235	VSSIDUM2	14	577.5
1236	VSSIDUM2	0	432.5
1237	VSSIDUM2	-14	577.5
1238	VSSIDUM2	-28	432.5
1239	S721	-42	577.5
1240	S722	-56	432.5
1241	S723	-70	577.5
1242	S724	-84	432.5
1243	S725	-98	577.5
1244	S726	-112	432.5
1245	S727	-126	577.5
1246	S728	-140	432.5
1247	S729	-154	577.5
1248	S730	-168	432.5

NO.	PAD NAME	X-axis	Y-axis
1249	S731	-182	577.5
1250	S732	-196	432.5
1251	S733	-210	577.5
1252	S734	-224	432.5
1253	S735	-238	577.5
1254	S736	-252	432.5
1255	S737	-266	577.5
1256	S738	-280	432.5
1257	S739	-294	577.5
1258	S740	-308	432.5
1259	S741	-322	577.5
1260	S742	-336	432.5
1261	S743	-350	577.5
1262	S744	-364	432.5
1263	S745	-378	577.5
1264	S746	-392	432.5
1265	S747	-406	577.5
1266	S748	-420	432.5
1267	S749	-434	577.5
1268	S750	-448	432.5
1269	S751	-462	577.5
1270	S752	-476	432.5
1271	S753	-490	577.5
1272	S754	-504	432.5
1273	S755	-518	577.5
1274	S756	-532	432.5
1275	S757	-546	577.5
1276	S758	-560	432.5
1277	S759	-574	577.5
1278	S760	-588	432.5
1279	S761	-602	577.5
1280	S762	-616	432.5
1281	S763	-630	577.5
1282	S764	-644	432.5
1283	S765	-658	577.5
1284	S766	-672	432.5
1285	S767	-686	577.5
1286	S768	-700	432.5
1287	S769	-714	577.5
1288	S770	-728	432.5
1289	S771	-742	577.5
1290	S772	-756	432.5
1291	S773	-770	577.5
1292	S774	-784	432.5
1293	S775	-798	577.5
1294	S776	-812	432.5
1295	S777	-826	577.5
1296	S778	-840	432.5
1297	S779	-854	577.5
1298	S780	-868	432.5
1299	S781	-882	577.5
1300	S782	-896	432.5
1301	S783	-910	577.5
1302	S784	-924	432.5
1303	S785	-938	577.5
1304	S786	-952	432.5
1305	S787	-966	577.5

NO.	PAD NAME	X-axis	Y-axis
1306	S788	-980	432.5
1307	S789	-994	577.5
1308	S790	-1008	432.5
1309	S791	-1022	577.5
1310	S792	-1036	432.5
1311	S793	-1050	577.5
1312	S794	-1064	432.5
1313	S795	-1078	577.5
1314	S796	-1092	432.5
1315	S797	-1106	577.5
1316	S798	-1120	432.5
1317	S799	-1134	577.5
1318	S800	-1148	432.5
1319	S801	-1162	577.5
1320	S802	-1176	432.5
1321	S803	-1190	577.5
1322	S804	-1204	432.5
1323	S805	-1218	577.5
1324	S806	-1232	432.5
1325	S807	-1246	577.5
1326	S808	-1260	432.5
1327	S809	-1274	577.5
1328	S810	-1288	432.5
1329	S811	-1302	577.5
1330	S812	-1316	432.5
1331	S813	-1330	577.5
1332	S814	-1344	432.5
1333	S815	-1358	577.5
1334	S816	-1372	432.5
1335	S817	-1386	577.5
1336	S818	-1400	432.5
1337	S819	-1414	577.5
1338	S820	-1428	432.5
1339	S821	-1442	577.5
1340	S822	-1456	432.5
1341	S823	-1470	577.5
1342	S824	-1484	432.5
1343	S825	-1498	577.5
1344	S826	-1512	432.5
1345	S827	-1526	577.5
1346	S828	-1540	432.5
1347	S829	-1554	577.5
1348	S830	-1568	432.5
1349	S831	-1582	577.5
1350	S832	-1596	432.5
1351	S833	-1610	577.5
1352	S834	-1624	432.5
1353	S835	-1638	577.5
1354	S836	-1652	432.5
1355	S837	-1666	577.5
1356	S838	-1680	432.5
1357	S839	-1694	577.5
1358	S840	-1708	432.5
1359	S841	-1722	577.5
1360	S842	-1736	432.5
1361	S843	-1750	577.5
1362	S844	-1764	432.5

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NO.	PAD NAME	X-axis	Y-axis
1363	S845	-1778	577.5
1364	S846	-1792	432.5
1365	S847	-1806	577.5
1366	S848	-1820	432.5
1367	S849	-1834	577.5
1368	S850	-1848	432.5
1369	S851	-1862	577.5
1370	S852	-1876	432.5
1371	S853	-1890	577.5
1372	S854	-1904	432.5
1373	S855	-1918	577.5
1374	S856	-1932	432.5
1375	S857	-1946	577.5
1376	S858	-1960	432.5
1377	S859	-1974	577.5
1378	S860	-1988	432.5
1379	S861	-2002	577.5
1380	S862	-2016	432.5
1381	S863	-2030	577.5
1382	S864	-2044	432.5
1383	S865	-2058	577.5
1384	S866	-2072	432.5
1385	S867	-2086	577.5
1386	S868	-2100	432.5
1387	S869	-2114	577.5
1388	S870	-2128	432.5
1389	S871	-2142	577.5
1390	S872	-2156	432.5
1391	S873	-2170	577.5
1392	S874	-2184	432.5
1393	S875	-2198	577.5
1394	S876	-2212	432.5
1395	S877	-2226	577.5
1396	S878	-2240	432.5
1397	S879	-2254	577.5
1398	S880	-2268	432.5
1399	S881	-2282	577.5
1400	S882	-2296	432.5
1401	S883	-2310	577.5
1402	S884	-2324	432.5
1403	S885	-2338	577.5
1404	S886	-2352	432.5
1405	S887	-2366	577.5
1406	S888	-2380	432.5
1407	S889	-2394	577.5
1408	S890	-2408	432.5
1409	S891	-2422	577.5
1410	S892	-2436	432.5
1411	S893	-2450	577.5
1412	S894	-2464	432.5
1413	S895	-2478	577.5
1414	S896	-2492	432.5
1415	S897	-2506	577.5
1416	S898	-2520	432.5
1417	S899	-2534	577.5
1418	S900	-2548	432.5
1419	S901	-2562	577.5

NO.	PAD NAME	X-axis	Y-axis
1420	S902	-2576	432.5
1421	S903	-2590	577.5
1422	S904	-2604	432.5
1423	S905	-2618	577.5
1424	S906	-2632	432.5
1425	S907	-2646	577.5
1426	S908	-2660	432.5
1427	S909	-2674	577.5
1428	S910	-2688	432.5
1429	S911	-2702	577.5
1430	S912	-2716	432.5
1431	S913	-2730	577.5
1432	S914	-2744	432.5
1433	S915	-2758	577.5
1434	S916	-2772	432.5
1435	S917	-2786	577.5
1436	S918	-2800	432.5
1437	S919	-2814	577.5
1438	S920	-2828	432.5
1439	S921	-2842	577.5
1440	S922	-2856	432.5
1441	S923	-2870	577.5
1442	S924	-2884	432.5
1443	S925	-2898	577.5
1444	S926	-2912	432.5
1445	S927	-2926	577.5
1446	S928	-2940	432.5
1447	S929	-2954	577.5
1448	S930	-2968	432.5
1449	S931	-2982	577.5
1450	S932	-2996	432.5
1451	S933	-3010	577.5
1452	S934	-3024	432.5
1453	S935	-3038	577.5
1454	S936	-3052	432.5
1455	S937	-3066	577.5
1456	S938	-3080	432.5
1457	S939	-3094	577.5
1458	S940	-3108	432.5
1459	S941	-3122	577.5
1460	S942	-3136	432.5
1461	S943	-3150	577.5
1462	S944	-3164	432.5
1463	S945	-3178	577.5
1464	S946	-3192	432.5
1465	S947	-3206	577.5
1466	S948	-3220	432.5
1467	S949	-3234	577.5
1468	S950	-3248	432.5
1469	S951	-3262	577.5
1470	S952	-3276	432.5
1471	S953	-3290	577.5
1472	S954	-3304	432.5
1473	S955	-3318	577.5
1474	S956	-3332	432.5
1475	S957	-3346	577.5
1476	S958	-3360	432.5

NO.	PAD NAME	X-axis	Y-axis
1477	S959	-3374	577.5
1478	S960	-3388	432.5
1479	S961	-3402	577.5
1480	S962	-3416	432.5
1481	S963	-3430	577.5
1482	S964	-3444	432.5
1483	S965	-3458	577.5
1484	S966	-3472	432.5
1485	S967	-3486	577.5
1486	S968	-3500	432.5
1487	S969	-3514	577.5
1488	S970	-3528	432.5
1489	S971	-3542	577.5
1490	S972	-3556	432.5
1491	S973	-3570	577.5
1492	S974	-3584	432.5
1493	S975	-3598	577.5
1494	S976	-3612	432.5
1495	S977	-3626	577.5
1496	S978	-3640	432.5
1497	S979	-3654	577.5
1498	S980	-3668	432.5
1499	S981	-3682	577.5
1500	S982	-3696	432.5
1501	S983	-3710	577.5
1502	S984	-3724	432.5
1503	S985	-3738	577.5
1504	S986	-3752	432.5
1505	S987	-3766	577.5
1506	S988	-3780	432.5
1507	S989	-3794	577.5
1508	S990	-3808	432.5
1509	S991	-3822	577.5
1510	S992	-3836	432.5
1511	S993	-3850	577.5
1512	S994	-3864	432.5
1513	S995	-3878	577.5
1514	S996	-3892	432.5
1515	S997	-3906	577.5
1516	S998	-3920	432.5
1517	S999	-3934	577.5
1518	S1000	-3948	432.5
1519	S1001	-3962	577.5
1520	S1002	-3976	432.5
1521	S1003	-3990	577.5
1522	S1004	-4004	432.5
1523	S1005	-4018	577.5
1524	S1006	-4032	432.5
1525	S1007	-4046	577.5
1526	S1008	-4060	432.5
1527	S1009	-4074	577.5
1528	S1010	-4088	432.5
1529	S1011	-4102	577.5
1530	S1012	-4116	432.5
1531	S1013	-4130	577.5
1532	S1014	-4144	432.5
1533	S1015	-4158	577.5

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NO.	PAD NAME	X-axis	Y-axis
1534	S1016	-4172	432.5
1535	S1017	-4186	577.5
1536	S1018	-4200	432.5
1537	S1019	-4214	577.5
1538	S1020	-4228	432.5
1539	S1021	-4242	577.5
1540	S1022	-4256	432.5
1541	S1023	-4270	577.5
1542	S1024	-4284	432.5
1543	S1025	-4298	577.5
1544	S1026	-4312	432.5
1545	S1027	-4326	577.5
1546	S1028	-4340	432.5
1547	S1029	-4354	577.5
1548	S1030	-4368	432.5
1549	S1031	-4382	577.5
1550	S1032	-4396	432.5
1551	S1033	-4410	577.5
1552	S1034	-4424	432.5
1553	S1035	-4438	577.5
1554	S1036	-4452	432.5
1555	S1037	-4466	577.5
1556	S1038	-4480	432.5
1557	S1039	-4494	577.5
1558	S1040	-4508	432.5
1559	S1041	-4522	577.5
1560	S1042	-4536	432.5
1561	S1043	-4550	577.5
1562	S1044	-4564	432.5
1563	S1045	-4578	577.5
1564	S1046	-4592	432.5
1565	S1047	-4606	577.5
1566	S1048	-4620	432.5
1567	S1049	-4634	577.5
1568	S1050	-4648	432.5
1569	S1051	-4662	577.5
1570	S1052	-4676	432.5
1571	S1053	-4690	577.5
1572	S1054	-4704	432.5
1573	S1055	-4718	577.5
1574	S1056	-4732	432.5
1575	S1057	-4746	577.5
1576	S1058	-4760	432.5
1577	S1059	-4774	577.5
1578	S1060	-4788	432.5
1579	S1061	-4802	577.5
1580	S1062	-4816	432.5
1581	S1063	-4830	577.5
1582	S1064	-4844	432.5
1583	S1065	-4858	577.5
1584	S1066	-4872	432.5
1585	S1067	-4886	577.5
1586	S1068	-4900	432.5
1587	S1069	-4914	577.5
1588	S1070	-4928	432.5
1589	S1071	-4942	577.5
1590	S1072	-4956	432.5

NO.	PAD NAME	X-axis	Y-axis
1591	S1073	-4970	577.5
1592	S1074	-4984	432.5
1593	S1075	-4998	577.5
1594	S1076	-5012	432.5
1595	S1077	-5026	577.5
1596	S1078	-5040	432.5
1597	S1079	-5054	577.5
1598	S1080	-5068	432.5
1599	S1081	-5082	577.5
1600	S1082	-5096	432.5
1601	S1083	-5110	577.5
1602	S1084	-5124	432.5
1603	S1085	-5138	577.5
1604	S1086	-5152	432.5
1605	S1087	-5166	577.5
1606	S1088	-5180	432.5
1607	S1089	-5194	577.5
1608	S1090	-5208	432.5
1609	S1091	-5222	577.5
1610	S1092	-5236	432.5
1611	S1093	-5250	577.5
1612	S1094	-5264	432.5
1613	S1095	-5278	577.5
1614	S1096	-5292	432.5
1615	S1097	-5306	577.5
1616	S1098	-5320	432.5
1617	S1099	-5334	577.5
1618	S1100	-5348	432.5
1619	S1101	-5362	577.5
1620	S1102	-5376	432.5
1621	S1103	-5390	577.5
1622	S1104	-5404	432.5
1623	S1105	-5418	577.5
1624	S1106	-5432	432.5
1625	S1107	-5446	577.5
1626	S1108	-5460	432.5
1627	S1109	-5474	577.5
1628	S1110	-5488	432.5
1629	S1111	-5502	577.5
1630	S1112	-5516	432.5
1631	S1113	-5530	577.5
1632	S1114	-5544	432.5
1633	S1115	-5558	577.5
1634	S1116	-5572	432.5
1635	S1117	-5586	577.5
1636	S1118	-5600	432.5
1637	S1119	-5614	577.5
1638	S1120	-5628	432.5
1639	S1121	-5642	577.5
1640	S1122	-5656	432.5
1641	S1123	-5670	577.5
1642	S1124	-5684	432.5
1643	S1125	-5698	577.5
1644	S1126	-5712	432.5
1645	S1127	-5726	577.5
1646	S1128	-5740	432.5
1647	S1129	-5754	577.5

NO.	PAD NAME	X-axis	Y-axis
1648	S1130	-5768	432.5
1649	S1131	-5782	577.5
1650	S1132	-5796	432.5
1651	S1133	-5810	577.5
1652	S1134	-5824	432.5
1653	S1135	-5838	577.5
1654	S1136	-5852	432.5
1655	S1137	-5866	577.5
1656	S1138	-5880	432.5
1657	S1139	-5894	577.5
1658	S1140	-5908	432.5
1659	S1141	-5922	577.5
1660	S1142	-5936	432.5
1661	S1143	-5950	577.5
1662	S1144	-5964	432.5
1663	S1145	-5978	577.5
1664	S1146	-5992	432.5
1665	S1147	-6006	577.5
1666	S1148	-6020	432.5
1667	S1149	-6034	577.5
1668	S1150	-6048	432.5
1669	S1151	-6062	577.5
1670	S1152	-6076	432.5
1671	S1153	-6090	577.5
1672	S1154	-6104	432.5
1673	S1155	-6118	577.5
1674	S1156	-6132	432.5
1675	S1157	-6146	577.5
1676	S1158	-6160	432.5
1677	S1159	-6174	577.5
1678	S1160	-6188	432.5
1679	S1161	-6202	577.5
1680	S1162	-6216	432.5
1681	S1163	-6230	577.5
1682	S1164	-6244	432.5
1683	S1165	-6258	577.5
1684	S1166	-6272	432.5
1685	S1167	-6286	577.5
1686	S1168	-6300	432.5
1687	S1169	-6314	577.5
1688	S1170	-6328	432.5
1689	S1171	-6342	577.5
1690	S1172	-6356	432.5
1691	S1173	-6370	577.5
1692	S1174	-6384	432.5
1693	S1175	-6398	577.5
1694	S1176	-6412	432.5
1695	S1177	-6426	577.5
1696	S1178	-6440	432.5
1697	S1179	-6454	577.5
1698	S1180	-6468	432.5
1699	S1181	-6482	577.5
1700	S1182	-6496	432.5
1701	S1183	-6510	577.5
1702	S1184	-6524	432.5
1703	S1185	-6538	577.5
1704	S1186	-6552	432.5

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NO.	PAD NAME	X-axis	Y-axis
1705	S1187	-6566	577.5
1706	S1188	-6580	432.5
1707	S1189	-6594	577.5
1708	S1190	-6608	432.5
1709	S1191	-6622	577.5
1710	S1192	-6636	432.5
1711	S1193	-6650	577.5
1712	S1194	-6664	432.5
1713	S1195	-6678	577.5
1714	S1196	-6692	432.5
1715	S1197	-6706	577.5
1716	S1198	-6720	432.5
1717	S1199	-6734	577.5
1718	S1200	-6748	432.5
1719	S1201	-6762	577.5
1720	S1202	-6776	432.5
1721	S1203	-6790	577.5
1722	S1204	-6804	432.5
1723	S1205	-6818	577.5
1724	S1206	-6832	432.5
1725	S1207	-6846	577.5
1726	S1208	-6860	432.5
1727	S1209	-6874	577.5
1728	S1210	-6888	432.5
1729	S1211	-6902	577.5
1730	S1212	-6916	432.5
1731	S1213	-6930	577.5
1732	S1214	-6944	432.5
1733	S1215	-6958	577.5
1734	S1216	-6972	432.5
1735	S1217	-6986	577.5
1736	S1218	-7000	432.5
1737	S1219	-7014	577.5
1738	S1220	-7028	432.5
1739	S1221	-7042	577.5
1740	S1222	-7056	432.5
1741	S1223	-7070	577.5
1742	S1224	-7084	432.5
1743	S1225	-7098	577.5
1744	S1226	-7112	432.5
1745	S1227	-7126	577.5
1746	S1228	-7140	432.5
1747	S1229	-7154	577.5
1748	S1230	-7168	432.5
1749	S1231	-7182	577.5
1750	S1232	-7196	432.5
1751	S1233	-7210	577.5
1752	S1234	-7224	432.5
1753	S1235	-7238	577.5
1754	S1236	-7252	432.5
1755	S1237	-7266	577.5
1756	S1238	-7280	432.5
1757	S1239	-7294	577.5
1758	S1240	-7308	432.5
1759	S1241	-7322	577.5
1760	S1242	-7336	432.5
1761	S1243	-7350	577.5
1762	S1244	-7364	432.5
1763	S1245	-7378	577.5
1764	S1246	-7392	432.5
1765	S1247	-7406	577.5
1766	S1248	-7420	432.5
1767	S1249	-7434	577.5
1768	S1250	-7448	432.5
1769	S1251	-7462	577.5
1770	S1252	-7476	432.5
1771	S1253	-7490	577.5
1772	S1254	-7504	432.5
1773	S1255	-7518	577.5
1774	S1256	-7532	432.5
1775	S1257	-7546	577.5
1776	S1258	-7560	432.5
1777	S1259	-7574	577.5
1778	S1260	-7588	432.5
1779	S1261	-7602	577.5
1780	S1262	-7616	432.5
1781	S1263	-7630	577.5
1782	S1264	-7644	432.5
1783	S1265	-7658	577.5
1784	S1266	-7672	432.5
1785	S1267	-7686	577.5
1786	S1268	-7700	432.5
1787	S1269	-7714	577.5
1788	S1270	-7728	432.5
1789	S1271	-7742	577.5
1790	S1272	-7756	432.5
1791	S1273	-7770	577.5
1792	S1274	-7784	432.5
1793	S1275	-7798	577.5
1794	S1276	-7812	432.5
1795	S1277	-7826	577.5
1796	S1278	-7840	432.5
1797	S1279	-7854	577.5
1798	S1280	-7868	432.5
1799	S1281	-7882	577.5
1800	S1282	-7896	432.5
1801	S1283	-7910	577.5
1802	S1284	-7924	432.5
1803	S1285	-7938	577.5
1804	S1286	-7952	432.5
1805	S1287	-7966	577.5
1806	S1288	-7980	432.5
1807	S1289	-7994	577.5
1808	S1290	-8008	432.5
1809	S1291	-8022	577.5
1810	S1292	-8036	432.5
1811	S1293	-8050	577.5
1812	S1294	-8064	432.5
1813	S1295	-8078	577.5
1814	S1296	-8092	432.5
1815	S1297	-8106	577.5
1816	S1298	-8120	432.5
1817	S1299	-8134	577.5
1818	S1300	-8148	432.5
1819	S1301	-8162	577.5
1820	S1302	-8176	432.5
1821	S1303	-8190	577.5
1822	S1304	-8204	432.5
1823	S1305	-8218	577.5
1824	S1306	-8232	432.5
1825	S1307	-8246	577.5
1826	S1308	-8260	432.5
1827	S1309	-8274	577.5
1828	S1310	-8288	432.5
1829	S1311	-8302	577.5
1830	S1312	-8316	432.5
1831	S1313	-8330	577.5
1832	S1314	-8344	432.5
1833	S1315	-8358	577.5
1834	S1316	-8372	432.5
1835	S1317	-8386	577.5
1836	S1318	-8400	432.5
1837	S1319	-8414	577.5
1838	S1320	-8428	432.5
1839	S1321	-8442	577.5
1840	S1322	-8456	432.5
1841	S1323	-8470	577.5
1842	S1324	-8484	432.5
1843	S1325	-8498	577.5
1844	S1326	-8512	432.5
1845	S1327	-8526	577.5
1846	S1328	-8540	432.5
1847	S1329	-8554	577.5
1848	S1330	-8568	432.5
1849	S1331	-8582	577.5
1850	S1332	-8596	432.5
1851	S1333	-8610	577.5
1852	S1334	-8624	432.5
1853	S1335	-8638	577.5
1854	S1336	-8652	432.5
1855	S1337	-8666	577.5
1856	S1338	-8680	432.5
1857	S1339	-8694	577.5
1858	S1340	-8708	432.5
1859	S1341	-8722	577.5
1860	S1342	-8736	432.5
1861	S1343	-8750	577.5
1862	S1344	-8764	432.5
1863	S1345	-8778	577.5
1864	S1346	-8792	432.5
1865	S1347	-8806	577.5
1866	S1348	-8820	432.5
1867	S1349	-8834	577.5
1868	S1350	-8848	432.5
1869	S1351	-8862	577.5
1870	S1352	-8876	432.5
1871	S1353	-8890	577.5
1872	S1354	-8904	432.5
1873	S1355	-8918	577.5
1874	S1356	-8932	432.5
1875	S1357	-8946	577.5

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NO.	PAD NAME	X-axis	Y-axis
1876	S1358	-8960	432.5
1877	S1359	-8974	577.5
1878	S1360	-8988	432.5
1879	S1361	-9002	577.5
1880	S1362	-9016	432.5
1881	S1363	-9030	577.5
1882	S1364	-9044	432.5
1883	S1365	-9058	577.5
1884	S1366	-9072	432.5
1885	S1367	-9086	577.5
1886	S1368	-9100	432.5
1887	S1369	-9114	577.5
1888	S1370	-9128	432.5
1889	S1371	-9142	577.5
1890	S1372	-9156	432.5
1891	S1373	-9170	577.5
1892	S1374	-9184	432.5
1893	S1375	-9198	577.5
1894	S1376	-9212	432.5
1895	S1377	-9226	577.5
1896	S1378	-9240	432.5
1897	S1379	-9254	577.5
1898	S1380	-9268	432.5
1899	S1381	-9282	577.5
1900	S1382	-9296	432.5
1901	S1383	-9310	577.5
1902	S1384	-9324	432.5
1903	S1385	-9338	577.5
1904	S1386	-9352	432.5
1905	S1387	-9366	577.5
1906	S1388	-9380	432.5
1907	S1389	-9394	577.5
1908	S1390	-9408	432.5
1909	S1391	-9422	577.5
1910	S1392	-9436	432.5
1911	S1393	-9450	577.5
1912	S1394	-9464	432.5
1913	S1395	-9478	577.5
1914	S1396	-9492	432.5
1915	S1397	-9506	577.5
1916	S1398	-9520	432.5
1917	S1399	-9534	577.5
1918	S1400	-9548	432.5
1919	S1401	-9562	577.5
1920	S1402	-9576	432.5
1921	S1403	-9590	577.5
1922	S1404	-9604	432.5
1923	S1405	-9618	577.5
1924	S1406	-9632	432.5
1925	S1407	-9646	577.5
1926	S1408	-9660	432.5
1927	S1409	-9674	577.5
1928	S1410	-9688	432.5
1929	S1411	-9702	577.5
1930	S1412	-9716	432.5
1931	S1413	-9730	577.5
1932	S1414	-9744	432.5

NO.	PAD NAME	X-axis	Y-axis
1933	S1415	-9758	577.5
1934	S1416	-9772	432.5
1935	S1417	-9786	577.5
1936	S1418	-9800	432.5
1937	S1419	-9814	577.5
1938	S1420	-9828	432.5
1939	S1421	-9842	577.5
1940	S1422	-9856	432.5
1941	S1423	-9870	577.5
1942	S1424	-9884	432.5
1943	S1425	-9898	577.5
1944	S1426	-9912	432.5
1945	S1427	-9926	577.5
1946	S1428	-9940	432.5
1947	S1429	-9954	577.5
1948	S1430	-9968	432.5
1949	S1431	-9982	577.5
1950	S1432	-9996	432.5
1951	S1433	-10010	577.5
1952	S1434	-10024	432.5
1953	S1435	-10038	577.5
1954	S1436	-10052	432.5
1955	S1437	-10066	577.5
1956	S1438	-10080	432.5
1957	S1439	-10094	577.5
1958	S1440	-10108	432.5
1959	SDUM2	-10122	577.5
1960	SDUM3	-10136	432.5
1961	VSS	-10150	577.5
1962	VSS	-10164	432.5
1963	VGL	-10178	577.5
1964	VGL	-10192	432.5
1965	VGL	-10206	577.5
1966	VGL	-10220	432.5
1967	VGL	-10234	577.5
1968	VGL	-10248	432.5
1969	VGL	-10262	577.5
1970	VGL	-10276	432.5
1971	VGL	-10290	577.5
1972	VGHO_L	-10304	432.5
1973	VGHO_L	-10318	577.5
1974	VGHO_L	-10332	432.5
1975	VGHO_L	-10346	577.5
1976	VGHO_L	-10360	432.5
1977	VGHO_L	-10374	577.5
1978	VGHO_L	-10388	432.5
1979	VGHO_L	-10402	577.5
1980	VSSIDUM1	-10416	432.5
1981	VSSIDUM1	-10430	577.5
1982	VSSIDUM1	-10444	432.5
1983	VSSIDUM1	-10458	577.5
1984	VSSIDUM1	-10472	432.5
1985	VSSIDUM1	-10486	577.5
1986	VSSIDUM1	-10500	432.5
1987	VSSIDUM1	-10514	577.5
1988	VSSIDUM1	-10528	432.5
1989	VSSIDUM1	-10542	577.5

NO.	PAD NAME	X-axis	Y-axis
1990	VSSIDUM1	-10556	432.5
1991	VSSIDUM1	-10570	577.5
1992	VSSIDUM1	-10584	432.5
1993	VSSIDUM1	-10598	577.5
1994	VSSIDUM1	-10612	432.5
1995	VSSIDUM1	-10626	577.5
1996	VSSIDUM1	-10640	432.5
1997	VSSIDUM1	-10654	577.5
1998	VSSIDUM1	-10668	432.5
1999	VSSIDUM1	-10682	577.5
2000	VSSIDUM1	-10696	432.5
2001	VSSIDUM1	-10710	577.5
2002	VSSIDUM1	-10724	432.5
2003	VSSIDUM1	-10738	577.5
2004	VSSIDUM1	-10752	432.5
2005	VSSIDUM1	-10766	577.5
2006	VSSIDUM1	-10780	432.5
2007	VSSIDUM1	-10794	577.5
2008	VSSIDUM1	-10808	432.5
2009	VSSIDUM1	-10822	577.5
2010	VSSIDUM1	-10836	432.5
2011	VSSIDUM1	-10850	577.5
2012	VSSIDUM1	-10864	432.5
2013	VSSIDUM1	-10878	577.5
2014	VSSIDUM1	-10892	432.5
2015	VSSIDUM1	-10906	577.5
2016	VSSIDUM1	-10920	432.5
2017	VSSIDUM1	-10934	577.5
2018	VSSIDUM1	-10948	432.5
2019	VSSIDUM1	-10962	577.5
2020	VSSIDUM1	-10976	432.5
2021	VSSIDUM1	-10990	577.5
2022	VSSIDUM1	-11004	432.5
2023	VSSIDUM1	-11018	577.5
2024	GOUT17	-11032	432.5
2025	GOUT17	-11046	577.5
2026	GOUT18	-11060	432.5
2027	GOUT18	-11074	577.5
2028	GOUT19	-11088	432.5
2029	GOUT19	-11102	577.5
2030	GOUT20	-11116	432.5
2031	GOUT20	-11130	577.5
2032	GOUT21	-11144	432.5
2033	GOUT21	-11158	577.5
2034	GOUT22	-11172	432.5
2035	GOUT22	-11186	577.5
2036	GOUT23	-11200	432.5
2037	GOUT23	-11214	577.5
2038	GOUT24	-11228	432.5
2039	GOUT24	-11242	577.5
2040	GOUT25	-11256	432.5
2041	GOUT25	-11270	577.5
2042	GOUT26	-11284	432.5
2043	GOUT26	-11298	577.5
2044	GOUT27	-11312	432.5
2045	GOUT27	-11326	577.5
2046	GOUT28	-11340	432.5

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NO.	PAD NAME	X-axis	Y-axis
2047	GOUT28	-11354	577.5
2048	GOUT29	-11368	432.5
2049	GOUT29	-11382	577.5
2050	GOUT30	-11396	432.5
2051	GOUT30	-11410	577.5
2052	VGL	-11424	432.5
2053	VGL	-11438	577.5
2054	VGL	-11452	432.5
2055	VRGH	-11466	577.5
2056	VRGH	-11480	432.5

NO.	PAD NAME	X-axis	Y-axis
2057	VRGH	-11494	577.5
2058	LVGL1	-11508	432.5
2059	LVGL1	-11522	577.5
2060	LVGL1	-11536	432.5
2061	GOUT31	-11550	577.5
2062	GOUT31	-11564	432.5
2063	GOUT32	-11578	577.5
2064	GOUT32	-11592	432.5
2065	VGL	-11606	577.5
2066	VGL	-11620	432.5

NO.	PAD NAME	X-axis	Y-axis
2067	VGL	-11634	577.5
2068	VGHO_L	-11648	432.5
2069	VGHO_L	-11662	577.5
2070	VGHO_L	-11676	432.5
2071	PADA4	-11690	577.5
2072	PADB4	-11704	432.5
2073	VSS	-11718	577.5
2074	VSS	-11732	432.5
2075	VSS	-11760	577.5

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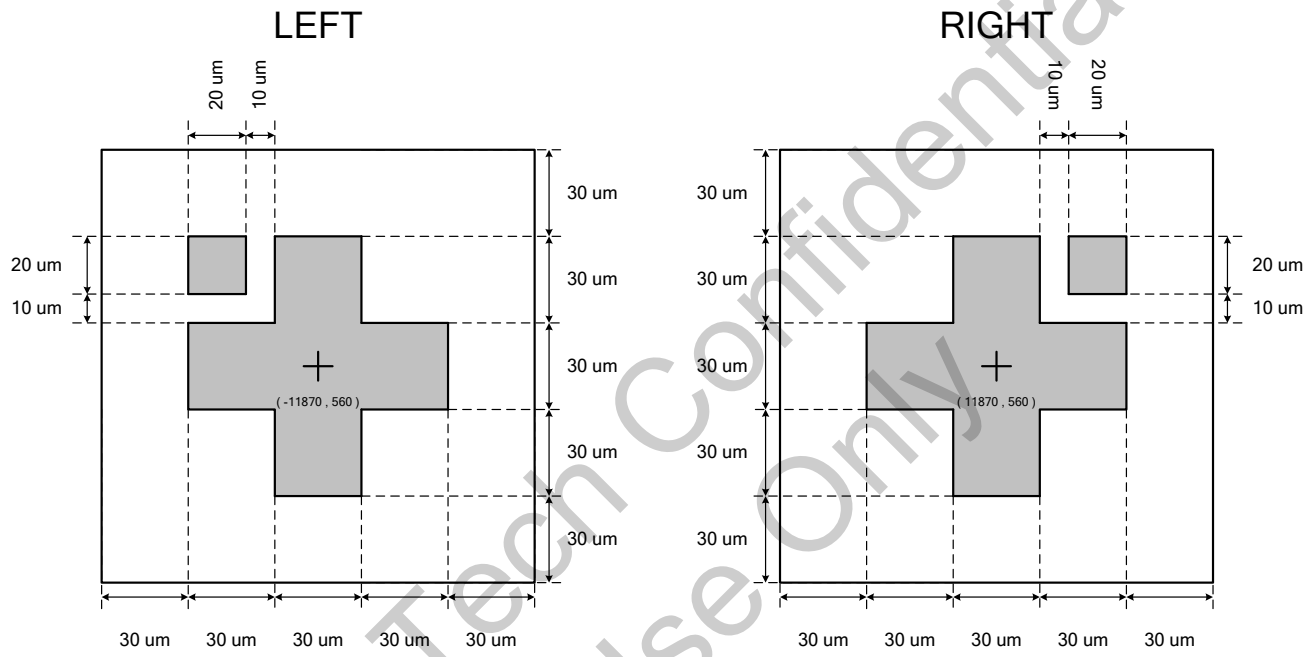
8.4. Alignment Mark

--Alignment Mark coordinate

Left (-11870, 560)

Right (11870, 560)

--Alignment Mark size



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10. REVISION HISTORY

Date	Revision #	Description	Page	Auditor
JUN.14,2012	0.92	Add “8.1 Pad assignment" Note3 & “8.2 PAD Dimension” Note3.	301	Gavin.Huang
JUN.12,2012	0.91	1. Modify “Feature”,add MIPI-DSI 1 data land rate up to 725Mb/s 2. Add PSWAP & DSWAP connected to ground if not used. 3. Add “5.3.18 OSC_DIV” 4. Add “5.3.33 PANCTRLSET1” ~ “5.3.40 PANCTRLSET8” & “5.3.41 PANU2D1” ~ “5.3.43 PANU2D3” & “5.3.44 PAND2U1” ~ “5.3.46 PAND2U3” 5. Add “5.3.77 SHARPEN” 6. Modify address D8001→D801 7. Modify address E311→E30F 8. Add “6.2.6 MIPI interface power on/off sequence” 9. Add “6.3.5 MDDI interface power on/off sequence” 10. Modify “7.2.1 Basic DC Characteristic” Current consumption 11. Add PWM OSC 12. Modify “8.1 Pad assignment" B3 size 80→70 13. Add “8.2 PAD Dimension” Note2 : Mark IC polish 14. Modify “8.3 PAD Location” PAD name	8 14 106 132~146 178 180 184 224 239-240 286-287 287 301 301 303~304 313~314	Gavin.Huang Jenny.Lee
MAR.22,2012	0.9	1. Modify “5.3.26 PWM PARA3” PWM Table 2. Modify “6.4.1 RGB interface color mapping Format” 3. Modify “6.7.2 SPI Read Mode” Protocal 4. Modify Chip thickness OTM8009A-C4 250um→200um 5. Remove “8.2 PAD Dimension” Chip thickness OTM8009A-C5 & OTM8009A-C6	123~124 221 240 280 280	Showmin.Hsiao
FEB.16,2012	0.8	1. Add MDDI/SPI Write Command Address 2. Delete “5.3.10 PAD_PARA2” & “5.3.11 PAD_PARA3”, Modify “5.3.9 PAD_PARA” 3. Add ”5.3.10 PANSET’ 4. Modify “5.3.13 PTSP1” Description 5. Delete “5.3.16 PTSP3” & “5.3.17 PTSP4”, Modify “5.3.16 SD_CTRL” 6. Delete ISC (Interval Scan Frame Setting) 7. Add “5.3.18 RGB_VIDEO_SET” 8. Modify “5.3.36 GOACLKA1” Description Figure 9. Modify “5.3.54 GOATGOPT” 10. Add “5.3.78 PRG_FLAG” 11. Modify Command Default Value 12. Modify “6.4.2” RGB Timing Parameter Table 13. Modify “6.7.2” SPI Read Mode 14. Modify OSC Frequence Table 15. Modify Boost Output Voltage Range 16. Add Chip thickness	26~87 98 99 102 104 105 108~109 133 155~156 178 92~171 224~226 241 267 267 281	Jenny.Lee Showmin.Hsiao
JAN.20,2012	0.7	1. Modify Pin Definition for VGSP, VGSN 2. Modify “5.3.8” IF_PARA2 Description 3. Modify “6.3.3.2” Video stream packet	17 96~98 212~213	Jenny.Lee Showmin.Hsiao

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JAN.12,2012	0.6	1. Pin Definition revised 2. Modify 5.3.9. PAD_PARA1 (B390H) IOPAD Parameter 1 Description. 3. Modify “5.3.20 OSC_ADJ” Table 4. Update “5.3.22” PWR_CTRL1 Default Value 5. Modify VDDA Clamp Voltage Setting 6. Remove “6.4” SHUT PIN Description 7. Modify “6.4.2 RGB Timing Parameter” Table 8. Modify “6.4.3” RGB interface power on/off sequence 9. Modify “7.3.1” MIPI-DSI characteristics 10. Modify Pad Assignment Format 11. Add chip thickness 200 um (OTM8009A-C2)	13,15,16,17 97 108 110 111 221 222~225 226 268~272 280 280	Jenny.Lee Showmin.Hsiao Tim Lin
DEC.21, 2011	0.5	Modify Basic DC characteristic	263	Jeff.Chen
DEC. 15, 2011	0.4	1. Gamma Correction Circuit 2. Pin Definition Revised 3. Modify Chip Thickness 4. Modify Name of Pad Location	11, 12 14 273 274-285	Jenny.Lee
NOV. 01, 2011	0.3	1. Pin Definition revised 2. Modify “5.3.25 PWR_CTRL4” Description 3. Modify “6.4.2 RGB Timing Parameter” Table 4. Modify SPI write RAM Protocal 5. Add chip thickness 250 um (OTM8009A-C1) 6. Modify PAD Size of 397, 2075 7. Modify Name of Pad Location	16,17 120 223 237 274 274 287	Jenny.Lee Showmin.Hsiao
AUG. 19, 2011	0.2	1. 480XRGBX480 Resolution for IC feature description 2. Add GM Register Setting Table 3. Modify Register Table for Power Control	8 97 110	Showmin.Hsiao
AUG. 05, 2011	0.1	Original.	290	Showmin.Hsiao

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